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Daniel Proto, et al

State University College

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16. *Abstract*

One hundred eighty-seven (187) papers concerning chemical aspects of Lake Ontario and influent tributaries were reviewed and abstracted. Each paper was cross-indexed by author, geographic area of lake and/or tributary in which study was performed, technique and instrumentation and parameters. In addition, a list of addresses for the authors and agencies was included along with other possibly pertinent references which the authors were not able to secure and review within the time limitations of the grant. (EPA Abstract)

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ANNOTATED BIBLIOGRAPHY OF LAKE ONTARIO LIMNOLOGICAL AND RELATED STUDIES

Vol. I - CHEMISTRY

By

Daniel Proto
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Project 16120 HVR

Project Officer

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I. INTRODUCTION

The purpose of this study, which was sponsored under grant # 16120 HVR from the U. S. Environmental Protection Agency, was to provide a reference that would be of aid to those individuals and/or agencies, planning or initiating limnological research on Lake Ontario and/or its tributaries, particularly those activities which are part of the International Field Year on the Great Lakes (1972-74). The task was divided on the basis of disciplines into three (3) sections - physical, biological and chemical. This paper is the final report from the latter.

The holdings of libraries in both the United States and Canada were surveyed. Each pertinent reference was abstracted and examined with respect to the parameters measured, techniques employed and the location(s) in which the study was conducted. In addition, the last known address of the agency or senior author was noted for inclusion of locating the author if further communication is desired.

Unless otherwise noted, the papers cited in the annotated list are located in Buffalo.

Due to limitations in time, we were unable to secure copies of a few references that may contain information relative to Lake Ontario. These have been included in this paper.

Comments concerning this work are welcome and appreciated.

II. SUBJECT INDEX

The number following each, refers to the number of the paper listed in Section III. Lake Ontario was divided into eighteen (18) regions, which are shown in Figure 1. The number nineteen (19) refers to lake-wide studies; while twenty (20) concerns tributaries to the lake. For the identification of the specific stream or river in question, see the abstract.

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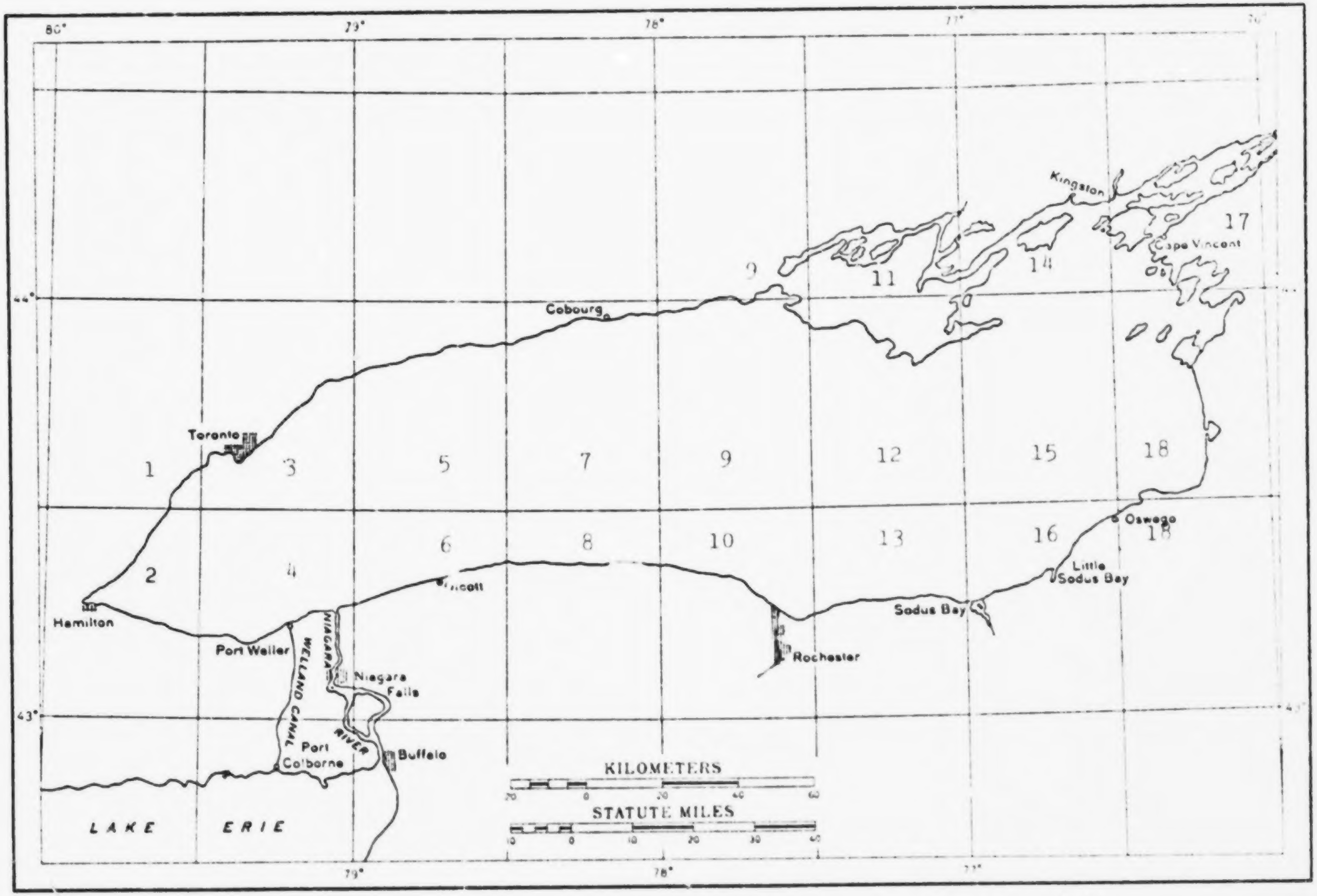

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III. ABSTRACTS

The location of those papers not found in Buffalo and available through the Great Lakes Lab are given in parenthesis at the end of the abstract.

1. Adamstone, F. B. 1924. The distribution and economic importance of the bottom fauna of Lake Nipigon with an appendix on the bottom fauna of Lake Ontario. Univ. Toronto. Studies. Biol. Ser. No. 25: 34-100.

   Contains data obtained from a series of dredgings made on October 3, 1922, in Lake Ontario on a line between Toronto and the mouth of the Niagara River. The parameters measured include: silica, insoluble silicates, Al and iron oxides, lime, SO_3, carbonates and organic matter. (Univ. of Toronto -- Zoology).

2. Allen, H. E. 1964. Chemical characteristics of Lake Ontario. Great Lakes Fish. Comm. Tech. Rept. No. 14: 1-18.

   Records are presented of Na, K, Ca, SiO_2, pH, alkalinity, O_2 and specific conductance at 106 stations in Lake Ontario. These data are compared for east-west and surface-subsurface variations. Water quality in Lake Ontario is similar to that in Lake Ontario with the exception of dissolved oxygen. The open waters of Lake Ontario had no areas of serious oxygen depletions.

   Anderson, D. V. - See: D. H. Matheson, No. 102, 103.

3. Anderson, D. V. and D. H. Matheson. 1967. Hamilton Bay - The model of a natural waste treatment reactor. Res. Rept. No. 73. Ontario Dept. Lands and Forest. 15 p.

   Hamilton Bay covers 11.3 square miles and discharges to Lake Ontario through a short shipping channel. All wastes from the city are discharged into the Bay, where, in water averaging 20 feet in depth, they are subject to active and effective decomposition. Analyses of the Bay water and lake water nearly have been made over 20 years, and during this period the Bay has been able to cope with the city's wastes. Increased pollution and reduced detention times now make problemmatical the stability of the Bay as a sewage reactor. Of course, the reactions are much too complicated yet to be discussed even qualitatively and, therefore, it is not possible to defend increased demands on the Bay. In any case, secondary treatment facilities are now being built. However, the Hamilton case shows that other restricted portions of the Great Lakes in metropolitan areas might possibly be segregated with similar benefits.

4. Anderson, D. V. (Ed.). 1969. The Great Lakes as an environment. Great Lakes Institute Univ. Toronto Rept. PR 39. 189 p. + appendices.

Contains tabulated data on the surface water of Lake Ontario. Parameters include hardness, Fe, alkalinity, SO_4, pH, K, Mg, C, chloroform extract, F, Cl, conductivity, Ca, Na+K, CO_3, SiO_3 and dissolved solids from 1906-07 to 1956. (CCIW).

5. Anon. 1970. Background papers for the Great Lakes environmental conference to be held in Toronto, Ontario. September 1970. 68 p.

Mercury concentrations in various Lake Ontario fish are given.

6. Atwater, W. O. 1892. The chemical composition and nutritive values of food-fishes and aquatic invertebrates. U. S. Commission Fish & Fisheries. Report for 1888, Part 16: 679-868.

Two lake trout (*Salvelinus nomaycush*) and one pike (*Esox lucius*) taken from Lake Ontario are chemically analyzed for total nitrogen, protein nitrogen, total ether extract, ash, albuminoids, P as P_2O_5, S as SO_3 and Cl.

Austin, T. S. - See: W. L. Tressler, No. 158

Austin, T. S. - See: W. L. Tressler, et.al., No. 159

7. Ayers, John C. 1962. Great Lakes waters, their circulation and physical and chemical characteristics. American Association for the Advancement of Science. Pub. No. 71: 71-89.

Chemical characteristics Great Lakes waters reflect their geological ages, their drainage area rocks and their peripheral human population densities. Only Lake Superior has shown no change in chemical characteristics in the past 50 to 75 years. Lake Erie, oldest and most heavily populated, has deteriorated in chemical quality during the past hundred years, with increasingly rapid eutrophication in the last fifty years.

Baldwin, A. L. - See: R. C. Bubeck, et.al., No. 18, 19.

Batoosingh, E. - See: R. O. Brinkhurst, et.al., No. 16.

Beeton, A. M. - See: J. E. Gannon, No. 60.

8. Beeton, A. M. 1965. Eutrophication of the St. Lawrence Great Lakes. Limnol. Oceanogr. 10: 240-254.

Lakes Huron, Michigan and Superior are classified as oligotrophic lakes on the basis of their biological, chemical and physical characteristics. Lake Ontario, although rich in nutrients, is morphometrically oligotrophic or mesotrophic because of its large area of deep water. Lake Erie, the most productive of the lakes and the shallowest, is eutrophic. Several changes commonly associated with eutrophication in small lakes have been observed in the Great Lakes. These changes apparently reflect accelerated eutrophication in the Great Lakes due to man's activities. Chemical data compiled from a number of sources, dating as early as 1854, indicate a progressive increase in the concentrations of various major ions and total dissolved solids in all of the lakes except Superior. The plankton has changed somewhat in Lake Michigan and the plankton, benthos and fish populations of Lake Erie are greatly different today from those of the past. An extensive area of hypolimnetic water of Lake Erie has developed low dissolved oxygen concentrations in late summer within recent years.

9. Beeton, A. M. 1966. Indices of Great Lakes eutrophication. Univ. Michigan, Great Lakes Res. Div. 15: 1-8.

The concept of eutrophication is discussed in terms of its relationship to aging of lakes, environmental changes and pollution. Various changes in physical, chemical and biological characteristics of the Great Lakes are reviewed. Increases in nitrogen and phosphorus, changes in species composition and increases in the abundance of plankton, decreases in the dissolved oxygen content of bottom waters, changes in fish populations in Lake Erie, the replacement of *Bosmina coregoni* by *B. longirostris*, and the extensive growths of *Cladophora* are acceptable indices of eutrophication and have been observed in other lakes. Increases in total dissolved solids and major ions may represent environmental changes not necessarily those of eutrophication. Changes in the benthic communities, amount of bacteria and growth rate of fish may be due to environmental conditions not related to eutrophication, although they may be useful indices of eutrophication if evaluated in terms of conditions in the total environment.

10. Beeton, A. M. 1969. Changes in the environment and biota of the Great Lakes. In: Eutrophication: Causes, Consequences, Correctives. National Academy of Sciences, Washington, D. C. 661 p.

Lake Ontario has some characteristics associated with eutrophic conditions and others indicating oligotrophy. The inflow of nutrient-rich waters from Lake Erie certainly is sufficient to stimulate high organic production, but the depth of the lake probably does not facilitate full utilization of the nutrients. Most of the lake is deeper than 120 ft. Consequently, it appears that Lake Ontario fits well into what Rawson (1960) called morphometrically oligotrophic. The relatively low transparency, high total dissolved solids and high specific conductance indicate eutrophic conditions (Beeton, 1965). Measurements of dissolved oxygen in 1966 did not confirm the low values reported previously that were cited by Beeton as evidence of eutrophication. Concentrations in the deep waters were usually 90 to 100 percent of saturation, although occasionally 70 percent saturation was found in one area in the shallow eastern part in 1966 (Dobson, 1967). Concentrations of the major ions are only a few ppm greater in Lake Ontario than in Lake Erie. Phosphorus concentrations in Lake Ontario, reported as about 0.01 to 0.028 ppm by Sutherland et.al. (1966), evidently are somewhat lower than in Lake Erie, although we do not have sufficient published data to support that conclusion.

11. Beeton, A. M. 1970a. Statement on pollution and eutrophication of the Great Lakes to the subcommittee on air and water pollution of the Committee of Public Works U. S. Senate. Univ. of Wisconsin-Milwaukee. 28 p.

Increases in total dissolved solids, calcium, chloride, sodium-plus-potassium and sulfate in Lake Ontario are the same as in Lake Erie, as would be expected, since the main inflow to Lake Ontario is from Lake Erie. The somewhat higher concentrations of salts in Lake Ontario than in Lake Erie is probably related to the growth of the Hamilton, Rochester and Toronto metropolitan areas. The agreement among the few early analyses, of 1854, 1884 and 1907 is close and indicates that increases in the chemical content of Lake Ontario, as well as Lake Erie, started around 1910.

12. Beeton, A. M. 1970b. Chemical characteristics of the Laurentian Great Lakes. In: R. A. Sweeney (Ed.) Proceedings of the Conference on Changes in the Chemistry of Lakes Erie and Ontario. Bull. Buffalo Soc. Nat. Sci. 25(2): 1-20.

The waters of the Great Lakes are bicarbonate and similar in concentrations of the major ions to the average fresh-water of North America. Lake Superior water has the lowest chemical content and the concentrations of the major ions increase as the waters flow through Lakes Huron, Erie and Ontario. Factors which affect the chemical characteristics of the Lakes are the geologic nature of the basin; chemical content of precipitation; inflows of tributaries (the inflows from other lakes are especially important in Lakes Erie, Huron and Ontario); the nature of man's use and intensity of that use of the watershed; major water movements; thermal stratification; depth of the lake; and extent of biological activity. Contains a table listing the major sources of chemical data for the Great Lakes giving the reference, kind of data and year of observation. Also included is a table of the average chemical characteristics of the Great Lakes.

13. Black, H. H. and E. Devendorf. 1954. Industrial pollution of international boundary waters along the Niagara Frontier. Sewage and Industrial Waters. 26(10): 1259-1285.

The paper discusses the average and maximum phenol concentrations entering Lake Ontario from the mouth of the Niagara River.

14. Bligh, E. G. 1970. Mercury contamination in fish. Twentieth Annual Institute for Public Health Inspectors, Winnipeg, Manitoba. (Oct. 19-23, 1970). 19 p.

The average ppm Hg in Lake Ontario pike is reported.

15. Bligh, E. G. 1971. Environmental factors affecting the utilization of Great Lakes fish as human food. Limnos. 4(1): 13-18.

Reports on the average Hg levels of various fish in different locations in Lake Ontario. Also contains some data on pesticide levels for Lake Ontario fish.

Breidenbach, A. W. - See: L. Weaver, et.al., No. 181.

16. Brinkhurst, R. O., K. E. Chua and E. Batoosingh. 1971. The free amino acids in the sediments of Toronto Harbor. Limnol. Oceanogr. 16(3): 555-559.

Seventeen amino acids were extracted from Toronto Harbor sediments, in concentrations that varied throughout the study period. Their relative abundance was the same at two locations, although higher near the mouth of the polluted Don River than near the islands.

17. Brydges, T. G. 1969. Investigations of daily variations in chemical bacteriological and biological parameters at two Lake Ontario locations near Toronto. Part I, Chemistry. Proc. 12th Conf. Great Lakes Res: 750-759.

An investigation of daily variations in chemical, bacteriological and algal parameters was carried out using samples collected five days a week from Toronto Harbour and from the intake of the R. C. Harris Filtration Plant. The intake extends 2500 m from shore and is 12 m deep in 23 m of water. The study began in July 1968. Weekly depth and sediment samples were collected to supplement the daily data.

Fourteen chemical parameters were monitored. Total phosphorus concentration was the best indicator of the presence of urban drainage. Ammonia and organic nitrogen concentrations in the harbour vary inversely; consequently, Kjeldahl nitrogen is a better measure of water quality than either of them. Surface nitrate concentrations vary with wind speed and biological activity and do not always reflect the effects of runoff. Chlorophyll and soluble phosphorus concentrations in the harbour vary inversely. Phosphorus was apparently not limiting algal growth, but there was insufficient data to test the relationship for the open lake.

Daily data were required to define some inter-parameter relationships which were not defined by data collected at weekly intervals.

18. Bubeck, R. C., W. H. Diment, B. L. Deck, A. L. Baldwin and S. D. Lipton. 1971a. Runoff of deicing salt: Effect on Irondequoit Bay, Rochester, New York. Science. 172: 1128-1132.

Salt used for deicing the streets near Rochester, New York, has increased the chloride concentration in Irondequoit Bay at least fivefold during the past two decades. During the winter of 1969-70 the quantity and salinity of the dense runoff that accumulated on the bottom of the bay was sufficient to prevent complete vertical mixing of the bay during the spring. Comparison with 1939 conditions indicates that the period of summer stratification has been prolonged a month by the density gradient imposed by the salt runoff.

19. Bubeck, R. C., W. H. Diment, B. L. Deck, A. L. Baldwin and S. D. Lipton. 1971b. Runoff of deicing salt: Effect on Irondequoit Bay, Rochester, New York. Proc. Street Salting Urban Water Quality Workshop. State Univ. College of Forestry, Syracuse, N. Y. pp 39-48.

Salt used for deicing the streets near Rochester, New York has increased the chloride concentration in Irondequoit Bay at least five fold during the past two decades. During the winter of 1969-1970, the quantity and salinity of the dense run-off that accumulated on the bottom of the bay was sufficient to prevent complete vertical mixing of the bay during the spring. Comparison with 1939 conditions indicates that the period of summer stratification has been prolonged a month by the density gradient imposed by the salt run-off.

20. Callender, E. 1970. The economic potential of ferromanganese nodules in the Great Lakes. Proc. 6th Forum on Geology of Industrial Minerals. Michigan Geological Survey, Miscellany 1. pp. 56-65.

Ferromanganese nodules occur in all of the St. Lawrence Great Lakes with the greatest deposits found to date in northern Lake Michigan. The Lake Michigan nodules average 20 percent iron and 8 percent manganese and occur as several types based upon physical and chemical properties. Nodules occur as concretionary material around a quartz or feldspar nucleus and ferromanganese oxide coatings on sand grains which are agglutinated into masses usually less than 3 mm in diameter. Chemically, the nodules consist of reddish brown high iron-low manganese material and dark brown high manganese-low iron masses. The trace element content of nodules is 1 to 2 orders of magnitude lower than marine material. Lake Michigan nodules contain unusually high concentrations of barium and arsenic which appear to be associated with hydrous manganese oxide. Reconnaissance sampling of the Upper Great Lakes revealed the presence of nodules at many localities exhibiting a similar geologic environment. Nodules always occur in oxidized sands that overlay stiff red and gray lacustrine clays. The nodules are extremely sensitive to oxidation-reduction potential and seldom occur in mildly oxidizing sediments. In conjunction with redox potential, sedimentation rates are the other important factor affecting the preservation of ferromanganese nodules. Synthesis of geological and geochemical data permit the evaluation of several parameters that may be useful in exploration for ferromanganese deposits in the Great Lakes.

21. Canada Centre for Inland Waters. 1969a. Lake Ontario limnological data report No. 1, 1966. Canadian Oceanographic Data Centre, Burlington, Ontario. 40 p.

Tabulated data for the surface waters of Lake Ontario are presented on: specific conductance, coliform count, temperature and total alkalinity. Descriptive statements are given for each sampling station where measurements were made. These statements include location of the station (longitude and latitude), date, time and depth of sample.

The data were obtained on two cruises of Lake Ontario. The first cruise extended from June 1-5, 1966 and consisted of 35 sampling locations situated on the eastern end of the lake. The second cruise was made from June 7-10, 1966 and 39 sampling locations were established over the entire lake except the extreme western end.

22. Canada Centre for Inland Waters. 1969b. Lake Ontario limnological data report No. 2, 1966. Canadian Oceanographic Data Centre, Burlington, Ontario. 54 p.

Tabulated data for the surface waters of Lake Ontario are presented on: temperature and coliform count. Descriptive statements are given for each sampling station where measurements were made. These statements include location (longitude and latitude), date, time and depth of sample.

This report contains water quality data obtained on a single cruise extending from June 15-19, 1966 on the eastern end of Lake Ontario.

23. Canada Centre for Inland Waters. 1969c. Lake Ontario limnological data report No. 3, 1966. Canadian Oceanographic Data Centre, Burlington, Ontario. 88 p.

Tabulated data for the surface waters of Lake Ontario are presented on: specific conductance, total alkalinity, dissolved oxygen, temperature, pH, nitrite and coliform count. Descriptive statements are given for each sampling station where measurements were made. These statements include location of the station (longitude and latitude), date, time and depth of sample.

The data were obtained on a single cruise extending from June 21-25, 1966 and covering the entire lake.

24. Canada Centre for Inland Waters. 1969d. Lake Ontario limnological data report No. 4, 1966. Canadian Oceanographic Data Centre, Burlington, Ontario. 113 p.

Tabulated data for the surface waters of Lake Ontario are presented on: specific conductance, total alkalinity, dissolved oxygen, pH, nitrite, temperature, coliform count, chloride, turbidity, phenol and hardness. Descriptive statements are given for each sampling station where measurements were made. These statements include location of the station (longitude and latitude), date, time and depth of sampling.

The data were obtained on a single cruise extending from June 26-30, 1966 and covering the area along the American shoreline with the exception of the far western end of the lake.

25. Canada Centre for Inland Waters. 1969e. Lake Ontario limnological data report No. 5, 1966. Canadian Oceanographic Data Centre, Burlington, Ontario. 125 p.

Tabulated data for the surface waters of Lake Ontario are presented on: total alkalinity, specific conductance, dissolved oxygen, pH, nitrite, temperature, coliform count, chloride, BOD, phenol and hardness. Descriptive statements are given for each sampling station where measurements were made. These statements include location of the station (longitude and latitude), date, time and depth of sampling.

The data were obtained on a single, lakewide, cruise extending from July 4-10, 1966.

26. Canada Centre for Inland Waters. 1969f. Lake Ontario limnological data report No. 6, 1966. Canadian Oceanographic Data Centre, Burlington, Ontario. 116 p.

Tabulated data for the surface waters of Lake Ontario are presented on: alkalinity, specific conductance, dissolved oxygen, pH, nitrite, temperature, coliform count, phenol, BOD, hardness and turbidity. Descriptive statements are given for each sampling station where measurements were made. These statements include location of the station (longitude and latitude), date, time and depth of sampling.

The data were obtained on two cruises of Lake Ontario. The first cruise extended from July 11-15, 1966 and consisted of 75 sampling locations situated over the entire lake except for the far eastern end. The second cruise was made from July 19-24, 1966 and 88 sampling stations were established over the entire lake.

27. Canada Centre for Inland Waters. 1969g. Lake Ontario limnological data report No. 7, 1966. Canadian Oceanographic Data Centre, Burlington, Ontario. 113 p.

Tabulated data for the surface waters of Lake Ontario are presented on: alkalinity, Cl, specific conductance, dissolved oxygen, pH, NO_2, hardness, phenols, turbidity, BOD, coliform count, temperature and reactive PO_4. Descriptive statements are given for each sampling station where measurements were made. These statements include location of the station (longitude and latitude), date, time and depth of sampling.

The data were obtained on two cruises of Lake Ontario. The frist cruise extended from July 26-29, 1966 and consisted of 62 sampling locations centered around two points on either side of mid-lake. The second cruise was made from August 2-7, 1966 and 79 sampling stations were established over the entire lake.

28. Canada Centre for Inland Waters. 1969h. Lake Ontario limnological data report No. 9, 1966. Canadian Oceanographic Data Centre, Burlington, Ontario. 119 p.

Tabulated data for the surface waters of Lake Ontario are presented on: alkalinity, Cl, specific conductance, dissolved oxygen, pH, NO_2, hardness, phenols, turbidity, BOD, coliform count, temperature, nitrate and nitrite N_2 and reactive PO_4. Descriptive statements are given for each sampling station where measurements were made. These statements include location of the station (longitude and latitude), date, time and depth of sampling.

The data were obtained on two cruises of Lake Ontario. The first cruise occurred in the period of August 15-19, 1966 and involved 69 sampling locations lakewide. The second cruise extended from August 29 through September 2, 1966 and consisted of 47 sampling locations situated around the lake.

29. Canada Centre for Inland Waters. 1969i. Lake Ontario limnological data report No. 10, 1966. Canadian Oceanographic Data Centre, Burlington, Ontario. 80 p.

Tabulated data for the surface waters of Lake Ontario are presented on: alkalinity, Cl, specific conductance, dissolved oxygen, pH, NO_2, hardness, phenols, turbidity, BOD, coliform count, temperature and reactive PO_4. Descriptive statements are given for each sampling station where measurements were made. These statements include location of the station (longitude and latitude), date, time and depth of sampling.

The data were obtained on two cruises of Lake Ontario. The first cruise took place between September 6-11, 1966 and covered the area around Toronto, mid-lake, and an extensive section of the eastern end of the lake. The second cruise extended from September 12-16, 1966 and was lakewide.

30. Canada Centre for Inland Waters. 1969j. Lake Ontario limnological data report No. 11, 1966. Canadian Oceanographic Data Centre, Burlington, Ontario. 109 p.

Tabulated data for the surface waters of Lake Ontario are presented on: alkalinity, Cl, specific conductance, dissolved oxygen, pH, NO_2, hardness, phenols, turbidity, BOD, coliform count, temperature, nitrate and nitrite N_2 and reactive PO_4. Descriptive statements are given for each sampling station where measurements were made. These statements include location of the station (longitude and latitude), date, time and depth of sampling.

The data were obtained on a single cruise extending from September 20-24, 1966. The sampling stations were located around the mouths of the Niagara, Genesee, Oswego and St. Lawrence Rivers.

31. Canada Centre for Inland Waters. 1969k. Lake Ontario limnological data report No. 12, 1966. Canadian Oceanographic Data Centre, Burlington, Ontario. 73 p.

Tabulated data for the surface water of Lake Ontario are presented on: dissolved oxygen, conductivity, alkalinity, Cl, temperature, coliform count, pH, turbidity, BOD, NO_2, phenols, $NO_2 + NO_3\text{-}N_2$ and reactive PO_4. Descriptive statements also are included giving time, date and location of sampling.

The data were obtained on two cruises of Lake Ontario. The first cruise extended from September 26-29, 1966 and was lake-wide. The second cruise extended from October 1-3, 1966 and covered the eastern end of the lake.

32. Canada Centre for Inland Waters. 1970a. Lake Ontario limnological data report No. 1, 1967. Canadian Oceanographic Data Centre, Burlington, Ontario. 212 p.

Tabulated data for the surface water of Lake Ontario are presented on: Ca, Mg, Na, K, alkalinity, SO_4, Cl, conductivity, dissolved O_2, silica, pH, Mn, Sr Li, Cu, Pb, Zn, Cd, Cr, Ni, Co, hardness, phenols, turbidity, Fe, organic-N_2, $NO_3\text{-}N_2$, dissolved solids, Kjeldahl-N_2, BOD, coliform count, $NH_3\text{-}N_2$, temperature, chlorophyll a, NO_3, reactive PO_4 and color. Descriptive statements are included which give date and location of sampling.

The data were collected on three lake-wide cruises of Lake Ontario.

33. Canada Centre for Inland Waters. 1970b. Lake Ontario limnological data report No. 2, 1967. Canadian Oceanographic Data Centre, Burlington, Ontario. 179 p.

Tabulated data for the surface water of Lake Ontario are presented on: Ca, Mg, Na, K, alkalinity, SO_4, Cl, conductance, dissolved O_2, silica, pH, Mn, Sr, Li, Cu, Pb, Zn, Cd, Cr, Ni, Co, hardness, phenols, turbidity, Fe, organic-N_2, $NO_3\text{-}N$, $NH_3\text{-}N_2$, dissolved solids, Kjeldahl-N_2, BOD, coliform count, temperature, chlorophyll a, NO_3 and reactive PO_4. Descriptive statements are also included which give date and location of sampling.

The data were obtained on two lake-wide cruises. The first curise extended from July 25-30, 1967 and the second from August 5-10, 1967.

34. Canada Centre for Inland Waters. 1970c. Lake Ontario limnological data report No. 3, 1967. Canadian Oceanographic Data Centre, Burlington, Ontario. 232 p.

Tabulated data for the surface water of Lake Ontario are presented on: Ca, Mg, Na, alkalinity, SO_4, Cl, conductance, dissolved O_2, silica, pH, Mn, Sr, Li, Cu, Pb, Zn, Cd, Cr, Ni, Co, hardness, phenols, turbidity, Fe, organic-N_2, NO_3-N_2, NH_3-N_2, dissolved solids, Kjeldahl-N_2, BOD, coliform count, temperature, chlorophyll a, NO_3, reactive PO_4, total PO_4 and NO_2-N_2. Descriptive statements are included which give date and location of sampling.

The data were collected on three lake-wide cruises. The first cruise extended from August 21-25, 1967 and second from September 5-9, 1967 and the third from September 16-21, 1967.

35. Canada Centre for Inland Waters. 1970d. Lake Ontario limnological data report No. 4, 1967. Canadian Oceanographic Data Centre, Burlington, Ontario. 203 p.

Tabulated data for the surface water of Lake Ontario are presented on: Ca, Mg, Na, K, alkalinity, SO_4, Cl, conductance, dissolved O_2, silica, Ph, Mn, Sr, Li, Cu, Pb, Zn, Cd, Cr, Ni, Co, hardness, phenols, turbidity, Fe, organic-N_2, NO_3-N_2, NH_3-N_2, dissolved solids, Kjeldahl-N_2, BOD, coliform count, temperature, chlorophyll a, NO_3 and reactive PO_4. Descriptive statements are included which give sampling data and location.

The data were collected on three lake-wide cruises. The first extended from October 1-6, 1967, the second from October 17-21, 1967 and the third from October 28 to November 2, 1967.

36. Canada Centre for Inland Waters. 1970e. Lake Ontario limnological data report No. 1, 1968. Canadian Oceanographic Data Centre, Burlington, Ontario. 85 p.

Tabulated data for the surface waters of Lake Ontario are presented on: specific conductance, temperature, turbidity, pH, dissolved O_2, total PO_4, ammonia N_2, reactive PO_4, nitrate and nitrite N_2, silica, chlorophyll a, coliform count and color. Descriptive statements are given for each sampling station where measurements were made. These statements include location of the station (longitude and latitude), date, time and depth of sample.

The data were obtained on three lake-wide cruises of Lake Ontario. The first cruise extended from April 30 to May 3, 1968, the second cruise from May 27-30, 1968 and the third cruise from July 2-6, 1968.

37. Canada Centre for Inland Waters. 1970f. Lake Ontario limnological data report No. 2, 1968. Canadian Oceanographic Data Centre, Burlington, Ontario. 66 p.

Tabulated data for the surface waters of Lake Ontario are presented on: temperature, turbidity, specific conductance and dissolved oxygen. Descriptive statements are given for each sampling station where measurements were made. These statements include location of the station (longitude and latitude), date, time and depth of sample.

The data were obtained on three cruises of Lake Ontario. The first cruise was lake-wide and extended from July 23-28, 1968. The second cruise was also lake-wide and extended from August 19-22, 1968. The third cruise covered the entire lake except the extreme eastern end and extended from Sptember 8-13, 1968.

38. Canada Centre for Inland Waters. 1970g. Lake Ontario limnological data report No. 3, 1968. Canadian Oceanographic Data Centre, Burlington, Ontario. 100 p.

Tabulated data for the surface waters of Lake Ontario are presented on: temperature, turbidity, specific conductance, filtrable residue, pH, alkalinity, dissolved oxygen, total PO_4, ammonia N_2, nitrate and nitrite N_2, SO_4, F, Cl, SiO_2, total hardness, Ca, Mg, K, Na, chlorophyll a and coliform count. Descriptive statements are given for each sampling station where measurements were made. These statements include location of the station (longitude and latitude), date, time and depth of sample.

The data were obtained on three cruises of Lake Ontario. The first cruise was lake-wide and extended from October 5-9, 1968. The second cruise also extended over the entire lake and took place from October 27-31, 1968. The third cruise extended over the entire lake except for the western end and took place from November 17-22, 1968.

39. Chandler, D. C. 1964. The St. Lawrence Great Lakes. Verh. Internat. Verein. Limnol. 15: 59-75.

Contains a table of the average chemical characteristics of Great Lakes waters.

40. Chau, Y. K. and H. Saitoh. 1970. Determination of submicrogram quantities of mercury in lake waters. Environ. Sci. Technol. 4: 839-841.

A simple and sensitive method for the determination of submicrogram amounts of mercury in lake water was developed by combination of concentration by dithizone extraction and gas-phase atomic absorption. The mercury was first extracted by dithizone, back extracted by hydrochloric acid and then converted to vapor by a reduction-aeration reaction. Hg, Hg(I), Hg(II), and some organomercuric compounds were extracted by the present procedure. A sensitivity of 0.008 ug per liter (0.008 ppb) was achieved for water analysis. Standard deviations of 0.0087 and 0.0042 were found for Lake Ontario water samples containing 0.478 and 0.048 ug per liter of Hg, respectively.

41. Chau, Y. K., V. K. Chawla, H. F. Nicholson and R. A. Vollenweider. 1970. Distribution of trace elements and chlorophyll a in Lake Ontario. Proc. 13th. Conf. Great Lakes Res. pp. 659-672.

Horizontal and vertical distributions of concentrations of 12 trace elements (Cd, Cr, Co, Cu, Fe, Pb, Mn, Mo, Ni, V.•Zn) have been studied in Lake Ontario on three cruises (May, July and September, 1969), covering 45 stations on each cruise. Attempts have been made to correlate these with the distribution of subsurface chlorophyll a.

Chawla, V. K. - See: Y. K. Chau, et.al., No. 41

Chawla, V. K. - See: M. T. Shiomi, No. 140

Chawla, V. K. - See: R. R. Weiler, No. 182

42. Chawla, Vinod K. 1970. Changes in the water chemistry of Lakes Erie and Ontario. In: R. A. Sweeney (Ed.). Proceedings of the Conference on Changes in the Chemistry of Lakes Erie and Ontario. Bull. Buffalo Soc. Nat. Sci. 25(2): 30-64.

Changes in the water chemistry of Lakes Erie and Ontario resulting from changes in: location (both vertical and horizontal), season and time are discussed. Three categories are dealt with (1) nutrients, (2) major ions and (3) trace elements.

Chua, K. E. - See: R. O. Brinkhurst, et.al., No. 16

Coker, R. - See: R. R. Weiler, No. 184

Compton, B. - See: G. Zweig, et.al., No. 186

43. Corp of Engineers. Undated. Dredging and water quality problems in the Great Lakes. Buffalo, New York. 2: 1-38.

Contains a report on a dredging investigation of Great Sodus Bay done in the summer of 1967 under the Federal Water Pollution Control Administration.

Mud and water samples are analyzed for phosphate (total and dissolved), nitrogen (total and nitrate), solids (total and dissolved), dissolved oxygen, alkalinity, BOD, COD, nitrogen (organic and Kjeldahl), Cl, SiO_2, Ca, Fe, pH, Eh and conductivity.

44. Corps of Engineers. Undated. Dredging and water quality problems in the Great Lakes. Buffalo, New York. 6: 1-8.

This report contains data obtained during dredging operations in 1968 at Oswego Harbor, New York, Little Sodus Bay Harbor, New York and Rochester Harbor, New York.

The bottom sediments of Oswego Harbor are analyzed for solids, silica, pH, BOD, COD, oils and greases, Cl demand and total Kjeldahl nitrogen.

Water samples taken from Oswego Harbor (including the Oswego River and Lake Ontario) were analyzed for pH, conductivity, dissolved oxygen, BOD, COD, alkalinity,Cl, ammonia, nitrogen, nitrate nitrogen, organic nitrogen, phosphated (total and soluble) and suspended solids.

The water in Little Sodus Bay and the lake water just outside the bay were analyzed for pH, conductivity, dissolved oxygen, BOD, COD, alkalinity, Cl, ammonia nitrogen, organic nitrogen, nitrate nitrogen, phosphate (total and soluble) and suspended solids.

The water of Rochester Harbor, the Genesee River and Lake Ontario at the Genesee's outlet is analyzed for pH, conductivity, dissolved oxygen, BOD, COD, Cl, alkalinity, ammonia nitrogen, nitrate nitrogen, organic nitrogen, phosphate (total and soluble), suspended solids and turbidity.

45. Corp of Engineers. 1971. Environmental statement Oswego Steam Station-Unit 5 Niagara Mohawk Power Corporation. U. S. Army Corps of Engineers, Buffalo, New York. 153 p.

Tabulated data for the surface water of the Oswego River at Hinmansville and Lake Ontario at the Oswego City water intake are presented on: color, turbidity, temperature, dissolved O_2, BOD, hardness, alkalinity, ammonia N_2, organic N_2, nitrate N_2, nitrite N_2, PO_4, SO_4, suspended and dissolved solids and coliform count.

46. Cronan, D. S. and R. L. Thomas. 1970. Geochemistry of ferromanganese oxide concretions in Lake Ontario. Proceedings of Annual Meeting of Geological Soc. Amer. p. 529. (Abstract of unpublished paper presented at the annual meeting of the Geol. Soc. of Amer., Milwaukee, Wisconsin, November 11-13, 1970).

A large deposit of ferromanganese oxide coated sands and scattered manganese nodules extends 210 km east from Toronto with a maximum width of 20 km and thickness of 4 cm. The ferromanganese oxides are X-ray amorphous and their Fe and Mn contents similar to those in concretions from other environments. However, their Ni, Cu, Zn and Co contents are lower than in deep-sea nodules, but higher than in previously described North American lake concretions possibly as a result of their lower growth rates. Lead is very high and exceeds the concentrations normally found in marine nodules. On a regional scale, Mn, Ni, Co and Zn are intercorrelated and vary inversely with Fe. These variations could partly be related to Eh since the Mn/Fe ratio increases with increase in Eh from south to north across the deposit.

Spark-source mass spectrographic analysis nodules from one site together with a deep-sea nodule for comparison shows that B, S, Cl, V, As, Br, Rb, Mo, I, Cs, La, Ce, Pr and Sm are enriched in the latter; Li, Cr, Ba and Hf in the former; and Be, P, Se, Ti, Ge, Sc, Y, Zr, Nb, Pd, Nd, Eu, Gd, Tb, Dy, Ho, Er, Yb and Tl are present in similar concentrations in each. Analyses of interstitial and bottom waters associated with the concentrations show that Mn, Fe, Ni, Cu, Pb and Zn are highest in the former suggesting that upward diffusion of these elements from buried sediments might be contributing to concretion formation.

Deck, B. L. - See: R. C. Bubeck, et.al., No. 18, 19.

Devendorf, E. - See: H. H. Black, No. 13

Diment, W. H. - See: R. C. Bubeck, et.al., No. 18, 19.

47. Dobson, Hugh H. 1967. Principal ions and dissolved oxygen in Lake Ontario. Proc. 10th Conf. Great Lakes Res. pp. 337-356.

In 1966, the rates of increase of ionic concentrations in Lake Ontario were: sodium, 21% per decade; chloride, 19% per decade; sulfate, about 6% per decade; and calcium, about 3% per decade. Alkalinity and the concentrations of magnesium and potassium were not changing at measurable rates. Total salt content and specific conductance were increasing by 4% per decade.

In the summer of 1966, the lower limit for dissolved oxygen in the main basin of Lake Ontario was 70% saturation. In early summer, near surface waters had percent saturation values as great as 155. The mean percent saturation in the hypolimnion was 100 in June and 94 in September.

48. Dole, R. B. 1909. The quality of surface waters in the United States. Part I - Analysis of waters east of the 100th meridian. U. S. Geological Survey, Water Supply Paper # 236. 123 p.

Water quality data are tabulated for samples taken from the St. Lawrence River at Ogdensburg, New York, from September 18, 1906 to August 18, 1907.

49. Faigenbaum, H. M. 1930. Chemical investigation of the St. Lawrence watershed. In: A Biological Survey of the St. Lawrence Watershed. Suppl. 20th Ann. Rept. (1930), New York State Conservation Dept. pp. 167-191.

Water quality data are tabulated for water samples taken from various points along the St. Lawrence River and its tributaries.

The parameters measured included temperature, carbon dioxide, alkalinity, dissolved oxygen and pH.

50. Faigenbaum, H. M. 1931. Chemical investigation of the Oswegatchie and Black River Watersheds. In: A Biological Survey of the Oswegatchie and Black River Systems. Suppl. 21st. Ann. Rept., New York State Conservation Dept. pp. 150-188.

Water quality data were obtained for water samples taken from various points along the Oswegatchie and Black River systems. Samples were collected at the mouths of the St. Lawrence and Black Rivers.

The parameters measured included temperature, carbon dioxide, alkalinity, dissolved oxygen and pH.

51. Faigenbaum, H. M. 1940. Chemical investigation of the Lake Ontario watershed. In: A Biological Survey of the Lake Ontario Watershed. Bio. Surv. (1939), (16), Suppl. 29th Ann. Rept., New York State Conservation Dept. pp. 117-146.

Pollution studies involving determinations of free carbon dioxide, dissolved oxygen, alkalinity and hydrogen ion concentration, as well as measurements of temperature and depth, were made on the principle streams, reservoirs, lakes, ponds and bay areas of the watershed. The principle types of pollution were found to be those due to sewage, cannery waste, milk and milk products and miscellaneous wastes. The effects of these are evaluated from the chemical data obtained.

52. Federal Water Pollution Control Administration. 1966. Statement on water pollution in the Lake Ontario Basin prepared for the Natural Resources and Power Subcommittee of the House Committee on Government Operations. Fed. Water Poll. Control Admin., U. S. Dept. of Interior, Great Lakes Region, Chicago, Illinois. Unnumbered.

Problems related to water pollution have been identified in Lake Ontario and most of its tributary streams. Some of these waters, particularly Lake Ontario, are experiencing the effects of over-fertilization which promotes massive growths of algae. These growths, sometimes called "blooms" seriously impair many important water uses and cause objectionable nuisance conditions that often exceed the tolerance levels of even the most insensitive persons.

Other waters are seriously degraded, adversely affecting desirable beneficial uses. Water supplies, swimming, boating, fishing and esthetic enjoyment are among the uses impaired by this degradation. Except for certain streams in the hinterland areas of the watershed where man's activities are minimal, there is evidence of pollution effects practically everywhere in the water environment. While some of the effects are minor impairments today, they are the harbingers of more serious conditions that are sure to develop as a result of population and economic growth in the years ahead if effective measures are not taken at the right time in the necessary places.

This report contains data on the waste which is directly discharged into the surface waters of Lake Ontario. Chapter 6 contains water quality data for Lake Ontario. The parameters measured include pH, alkalinity, dissolved oxygen, BOD, COD, phosphate, ammonia, organic and nitrate nitrogen, chlorides, specific conductance, potassium, sodium, dissolved solids and chlorophyll.

53. Federal Water Pollution Control Administration. 1967a. Lake Ontario program - A water pollution control program for the Genesee River Basin. Fed. Water Poll. Control Admin. Great Lakes Region, Rochester, New York and New York State Dept. Health Environmental Health Service, Albany, New York. 117 p. + bibliograph.

This report is a survey of the major pollution problems, the present and anticipated sources of pollution and the water uses and trends in water usage of the Genesee River Basin.

Tabulated data are presented for the surface waters of the Genesee River. The parameters measured include dissolved oxygen, BOD, pH, coliform count, ABS, turbidity, temperature, dissolved solids, color and phosphorus.

54. Federal Water Pollution Control Administration. 1967b. A water pollution control program for the Black River and U. S. St. Lawrence River Basins. U. S. Dept. Health, Environmental Health Service and FWPCA, Washington, D. C. Unnumbered.

This report is a survey of the major pollution problems, the present and anticipated sources of pollution and the water uses and trends in water usage of the Black and St. Lawrence River Basins.

Tabulated data are presented on the surface waters of both river basins. The parameters measured include pH, temperature, BOD, COD, ammonia, nitrate, chlorides, alkalinity, hardness, turbidity, sulphate, phosphate, total dissolved solids, specific conductance and coliform count. The data of sampling and the location of each sampling station are also given.

55. Federal Water Pollution Control Administration. 1968. Industrial waste inventory - Lake Ontario and St. Lawrence River Basins Part I - Buffalo Area. Federal Water Pollution Control Admin., U. S. Dept. of Interior, Great Lakes Region, Rochester, New York. Unnumbered.

To effectively promote water quality improvement programs requires ready access to reliable up-to-date information on waste sources. This inventory is a working document that annually will be updated to reflect the current status of industrial wastes within the Lake Ontario and U. S. St. Lawrence River Basins.

The parameters measured include BOD, COD, suspended solids, dissolved solids, phenols, pH and oils.

56. Federal Water Pollution Control Administration and the New York State Department of Health. 1968a. Water pollution and improvement needs - Lake Ontario and St. Lawrence River Basins. Federal Water Pollution Control Admin., U. S. Dept. of Interior, Washington, D. C. and Division of Pure Waters, New York State Dept. of Health, Albany, New York. 125 p.

This report summaries the water pollution problems of the U. S. waters of Lake Ontario and the St. Lawrence River and their tributaries. It identifies the causes of these problems or sources of pollution, discusses the improvements needed and presents a program of recommended actions.

The areas covered in this report are Lake Ontario, the Niagara River Basin, the Oswego River Basin, The Black River Basin and the U. S. St. Lawrence River Basin.

57. Federal Water Pollution Control Administration and the New York State Department of Health. 1968b. Lake Ontario program - A water pollution control program for the minor tributary basins of Lake Ontario. Federal Water Pollution Control Admin., U. S. Dept. of Interior, Rochester Program Office and the Environmental Health Service, New York State Dept. Health, Rochester and Albany, New York. Unnumbered.

This report presents information on the minor tributary area of Lake Ontario concerning sources of municipal and industrial waste, water quality conditions, future waste loads, anticipated water uses, estimated improvement costs; contains recommendations for future water quality improvements by the Federal Water Pollution Control Administration and the New York State Department of Health.

The area within the scope of this report includes the land drained directly and by minor tributaries to the lake, extending approximately from Niagara Falls to Watertown, New York. It is situated in the counties of Jefferson, Lewis, Oswego, Cayuga, Wayne, Ontario, Monroe, Orleans, Genesee and Niagara.

The water quality conditions in the Rochester embayment of Lake Ontario and the lower Genesee River are of particular importance to this study.

Water quality data tabulated for water samples collected on the Genesee, Black, Niagara and Oswego Rivers, Eighteen Mile Creek, Little Sodus Bay, Irondequoit Bay and Lake Ontario.

The parameters measured include dissolved phosphate, total nitrogen, ammonia and nitrate nitrogen, chlorides, specific conductance, sulphate, sodium, potassium, calcium, dissolved solids, alkalinity, BOD, dissolved oxygen, pH and coliforms.

58. Fenlon, M. W., D. C. McNaught and G. D. Schroder. 1971. Influences of thermal effluents upon aquatic production in Lake Ontario. Abstracts of paper presented at the 14th Conference on Great Lakes Research, Toronto. April 19-21, 1971. pp. 173-174.

Thermal effluents from nuclear power plants create potential environmental problems which concern heat and/or radionuclide buildup in the ecosystem. Additions of heat might be expected to modify the rate of production of phytoplankton in localized areas.

In order to determine the effects of the thermal outfall from the Niagara Mohawk plant at Nine Mile Point, Lake Ontario, sampling stations were located in lines perpendicular to the plant's outfall, as well as the immediate vicinity. Primary productivity was estimated using ^{14}C techniques, with samples incubated *in situ*. Zooplankters were collected with the Isaacs-Kidd high-speed sampler Estimates of instantaneous birth rates and death rates were determined using egg ratio techniques for eight cladocerans and four copepods.

59. Fish and Wildlife Service. 1969. Fish and wildlife as related to water quality. Special Report on Fish and Wildlife Resources. U. S. Dept. of Interior, Washington, D. C. 128 p.

Lake Ontario's inshore waters do not exhibit obvious signs of water quality degradation, except in the vicinity of major urban concentrations. The rapid proliferation of *Cladophora* since the 1950's is evident of accelerated enrichment of these inshore waters. Oil pollution, origination from vessels is also a serious problem.

Water quality is still high in the open waters of Lake Ontario, although there has been change. Concentrations of total dissolved solids have increased at an accelerated rate since 1910, paralleling the increases that have taken place in Lake Erie. Lake Ontario concentrations are slightly higher than Lake Erie, due to the addition of inputs from its own basin to the waters it receives from Lake Erie.

Despite higher concentrations of various dissolved solids than occur in Lake Erie, the open water of Lake Ontario has not developed comparable worsening of environmental conditions. Concentrations of dissolved oxygen are generally high, except for a few localities in the eastern end of the lake. Benthic fauna flourishes throughout the lake. The morphometry of Lake Ontario and its comparatively low load of suspended solids probably contribute to the failure to develop adverse conditions comparable to Lake Erie.

Preliminary investigations indicate that concentrations of pesticides such as DDT and dieldrin in fish do not follow the Lake Erie pattern. These substances are present in almost negligible concentrations in Lake Erie fish, whereas Lake Ontario concentrations are roughly equivalent to those of Lake Huron. This indicates buildup from within the Lake Ontario Basin itself to levels only one-half to one-third lower than measured in Lake Michigan fish. From the fisheries standpoint, this aspect of water quality demands the most immediate remedial action.

Although water quality changes to date throughout the Lake Ontario ecosystem have not proceeded to a point resulting in demonstrable adverse effects in fish and wildlife resources, the changes that have taken place should be viewed seriously. They are indicators that steps should be taken without delay to slow down, and eventually halt, inputs of pollution. The pollution control plan, as outlined in this Federal Water Pollution Control Administration report should be implemented as a necessary first step.

Fox, M. E. - See: R. R. Weiler, No. 183

60. Gannon, J. E. and A. M. Beeton. 1969. Studies on the effects of dredged materials from selected Great Lakes Harbors on plankton and benthos. Center for Great Lakes Studies, Univ. Wisconsin - Milwaukee. Spec. Rept. No. 8. 82 p.

Sediment from the harbors of Buffalo, N. Y.; Calumet, Ill.; Cleveland, Ohio; Great Sodus Bay, N. Y.; Green Bay, Wisc.; Indiana Harbor, Ind.; Milwaukee, Wisc.; Rouge River (Detroit, Mich.); and Toledo, Ohio were analyzed for: COD, NH_3-N_2, organic N_2, PO_4-P and volatile solids. The ^{14}C uptake of Lake Michigan phytoplankton was also studied when subjected to various concentrations of harbor sediment extract.

Giese, G. L. - See: W. G. Weist, No. 185

61. Gilbert, B. K. and J. C. Kammerer. 1965. Summary of water resources records at principal measurement sites in the Genesee River basin through 1963. New York State Water Resources Commission Bull. 56. 55 p.

This report is a tabular summary of more than half a century of water measurements (mainly streamflow) in the Genesee River basin by the U. S. Geological Survey, usually in cooperation with State and other Federal agencies. The range in streamflow is from less than 1cfs (cubic foot per second) during dry-weather periods on five tributaries measured, to a flood flow on the Genesee River itself of more than 55,000 cfs, near Mount Morris on May 17, 1916. The average flow of the Genesee River at Rochester is 2,738 cfs, equal to a basinwide runoff of 1.1 cfs per square mile, or 15 inches of water annually.

The chemical quality of streams in the basin varies widely in time and from place to place, generally being more highly mineralized in downstream areas than in upstream areas. The average dissolved solids content of the Genesee River during water year 1965 was 158 ppm at Scio and 349 ppm at Rochester.

Ground-water levels measured in three wells for more than ten years, show no long-term decline of the water table. Generally, water levels are highest in the spring and lowest in the late summer or fall.

62. Glooschenko, W. A. 1971. The effect of DDT and dieldrin upon ^{14}C uptake by *in situ* phytoplankton in Lakes Erie and Ontario. Unpublished paper presented at the 14th Conference on Great Lakes Research. April 19-21, 1971. Toronto. 9 p.

In situ studies were performed upon the effects of DDT and dieldrin to phytoplankton in Lake Ontario in May, 1970 and Lake Erie in July and October, 1970. To water samples, concentrations of 1, 10, 100 and 1000 ppb DDT and dieldrin (Lake Erie only) were added. The response of the phytoplankton was measured by ^{14}C uptake over five-hour intervals.

On Lake Ontario, 1 ppb DDT was sufficient to cause a decrease of ^{14}C uptake by 12.3%. On four stations occupied in Lake Erie in July, and three in October, DDT at 1 ppb caused in ^{14}C uptake from 4.2-28.1% in July and 1.2-29.1% in October. Dieldrin decreased ^{14}C uptake to a greater extent. A decrease of 30.7-74.7% was found at 1 ppb in July and 9.0-36.4% in October. At the higher concentrations used of 10, 100 and 1000 ppb greater reduction of ^{14}C was noticed.

The inhibition of ^{14}C uptake by DDT and dieldrin does not appear to be important in the Great Lakes *in situ* except possibly in local areas of high run-off from agricultural sources. The major problem appears to be concentration of these pesticides by algae and transfer to higher trophic levels.

63. Great Lakes Institute. 1964. Great Lakes Institute data record 1962 surveys. Part 1 - Lake Ontario and Lake Erie. Univ. Toronto, Great Lakes Institute Preliminary Rept. 16. 97 p.

Report contains chemical analysis data of water samples collected on a monitor survey of western and central Lake Ontario. This survey (0-62-3) was conducted with the research vessel Porte Dauphine from December 12-14, 1962.

The parameters measured include: alkalinity, conductance, dissolved oxygen, pH, color and temperature.

64. Great Lakes Institute. 1965. Great Lakes Institute data record 1963 surveys. Part 1 - Lake Ontario, Lake Erie and Lake St. Clair. Univ. Toronto, Great Lakes Institute Preliminary Rept. 23. 195 p.

Chemical analysis of water samples collected during cruises of Lake Ontario in 1963 by the research vessel Porte Dauphine are tabulated.

The following cruises contain chemical data: 0-63-4; 0-63-5; 0-63-8; 0-63-22; 0-63-29; 0-63-31.

The parameters measured include: alkalinity, conductance, dissolved oxygen, pH, Cl, hardness, Fe, total and soluble PO_4, turbidity and dissolved solids.

65. Great Lakes Institute. 1971 Great Lakes Institute data record surveys in 1964 of the CCGS Porte Dauphine for Lake Ontario, Lake Erie, Lake St. Clair, Lake Huron, Georgian Bay and Lake Superior. Univ. Toronto, Great Lakes Institute Preliminary Rept. 42. 238 p.

Chemical analysis data of water samples collected during cruises on Lake Ontario in 1964 by the research vessel Porte Dauphine are tabulated.

The following cruises contain chemical data: 0-64-5; 0-64-6; 0-64-8; 0-64-9; 0-64-13; 0-64-16; 0-64-17; 0-64-19.

The parameters measured include: alkalinity, conductance, dissolved oxygen, pH, turbidity, color and temperature.

Grey, C. B. J. - See: A. L. W. Kemp, et.al., No. 85

66. Grey, C. B. J. and A. L. W. Kemp. 1970. A quantitative method for the determination of chlorin pigments in Great Lakes sediment. Proceedings 13th Conference Great Lakes Research: 242-249 p.

A method for the extraction and quantitative measurement of chlorophylls a, b, c; pheophytin a, b; chlorophyllides a, b; pheophorbides a, b; and allmerized a and b chlorin pigments in lake sediments is described. The chlorin pigments are ultrasonically extracted in an acetone-methanol mixture, concentrated and separated by reverse-phase thin layer chromatography. The chlorins were eluted from each band and determined spectrophotometrically. The method had a precision of ± 6%.

Chlorin pigments were determined in six surface sediment samples from the main basins of Lakes Ontario and Erie. Chlorophyll a (0-10 ppm), allomerized chlorophyll a (0-1.3 ppm), pheophytin a (3.6-7.4 ppm) and pheophorbide a (6.7-17.3 ppm) were found in six samples. The absence of chlorophyll b and its degradation products suggested that the organic material at these stations was autochthonous organic matter.

Gunnerson, C. G. - See: L. Weaver, et.al., No. 181.

Harris, A. J. - See: J. R. Vallentyne, et.al., No. 177

67. Hart, J. L. 1931. The spawning and early life history of the whitefish *Coregonus clupeaformis* (Mitchell) in the Bay of Qunite, Ontario. Contributions to Canadian Biology and Fisheries New Series. 6(7): 165-214.

Determinations of pH, O_2 and temperature were made on the surface water of the Bay of Quinte, Lake Ontario on two occasions.

On February 1, 1928, a water analysis showed the following: 9.7 ppm O_2; pH 7.5; 0 C.

On April 8, 1928, the bay water at Belleville had a pH of 7.4, a temperature of 4 C. and contained 8.1 ppm of O_2.

68. Hedrick, L. R. and M Soyugenc. 1967. Yeasts and molds in water and sediments of Lake Ontario. Proceedings 10th Conference Great Lakes Research. pp. 20-30.

Yeasts and molds were isolated from 27 widely distributed stations in Lake Ontario. Each station represented 4 samples, three from the water - the surface (1 meter), the mid-depth and near the bottom - and one from the bottom sediment. Organisms from the water were collected by filtration through membranes and cultures on a defined agar medium. The sediment samples (each 6.0 g wet wt.) were suspended in 100 ml of the defined liquid medium and four 10 ml portions of this suspension were pulled separately through membrane filters. These filters were than incubated on the defined agar medium. Colonies of representative fungi, which had grown within a period of 24 to 72 hours, were isolated by culturing them upon slants, for later identification.

Twenty species of yeast, representing 7 genera, were identified. Eight genera of molds were isolated.

The density distribution of fungi with respect to the depth of the water samples showed that the frequency of occurence increased with depth. For the 27 stations, the average number of yeasts isolated per 100 ml was: 10 for water at 1 meter, 130 for water at mid-depth and 460 for water near the bottom, sediment 46; the respective values for molds were 6, 16, 16 and 11.

Stepwise, multiple correlation analyses did not reveal any consistent association of any one parameter with the distribution of the two most numerous species, *Candida guilliermondii* and *Rhodotorula mucilaginosa*. For the total yeast population there was a definite relationship between the numbers of cells at the different water depths and the organic nitrogen and nitrate nitrogen concentrations at the corresponding depths.

69. Heinke, G. W. 1969. Hydrolysis of condensed phosphates in Great Lakes Waters. Proceedings 12th Conference Great Lakes Research. pp. 766-773.

Condensed phosphates from detergents in wastewater are a major supply of phosphorus to surface waters. They hydrolyze to orthophosphate, the form most readily available to plants and organisms. The chemical industry has carried out many studies on the rate of hydrolysis in distilled water. However, few investigations have been made in natural water and wastewater. This work concentrates on rate of hydrolysis studies of sodium tripolyphosphate and sodium pyrophosphate in Great Lakes water under conditions of temperature, pH and concentration occurring in the environment. The results of laboratory work and an experiment in Lake Ontario are presented. The quantitative effects of changes in these parameters on the rate are outlined. Comparisons with rates in other media are made.

70. Henderson, C., W. L. Johnson and A. Inglis. 1969. Organochlorine insecticide residues in fish (National Pesticide Monitoring Program). Pesticide Monitoring Journal. 3(3): 145-171.

As part of the National Pesticide Monitoring Program, fish were collected from 50 sampling stations located in the Great Lakes and in major river basins throughout the United States. Three composite samples, consisting of five adult fish of each of three species, were collected at all stations during the spring and fall of 1967 and 1968. The composite whole fish samples were analyzed by commercial laboratories for residues of 11 organochlorine insecticides. DDT and/or metabolites were found in 584 of the 590 composite samples, with values ranging to 45 ppm (mg/kg wet wt., whole fish). Dieldrin was found in 75% of the samples, with values ranging upward to nearly 2 ppm. Other organochlorine insecticides residues were found in fewer samples, but some had fairly high residue levels. Relatively high residues of DDT and metabolites, dieldrin, heptachlor epoxide and chlordane were found consistently during all sampling periods at some stations.

71. Herdendorf, C. E. 1970. Lake Erie physical limnology cruise, midsummer 1967. Report of Investigations No. 79, Ohio Dept. of Natural Resources Division of Geological Survey, Columbus, Ohio. 45 p. + Appendix.

Tabulated data and contour maps are presented for the surface waters of Lake Erie. Three of the sampling stations are located on the Niagara River. Parameters measured include temperature, specific conductance, pH, dissolved oxygen, chloride ions and turbidity. Descriptive statements are given for each sampling station where measurements were made. These statements include location of the station (longitude and latitude), water depth, surface observations, water color and remarks on the bottom sediment.

72. Hunt, T. S. 1857. The chemical composition of the waters of the St. Lawrence and Ottawa Rivers. Phil. Mag., Ser. 4, 13: 239-245.

Chemical analysis data are given for water samples from the St. Lawrence and Ottawa Rivers in 1854.

Inglis, A. - See: C. Henderson, et.al., No. 70

73. International Joint Commission. 1951. Report of the International Joint Commission United States and Canada on the pollution of boundary waters. Washington & Ottawa. 312 p.

Chemical analysis data for water samples taken from various locations on Lake Ontario and the Niagara River are tabulated.

The parameters measured are: chlorides, phenols, ammonia nitrogen, temperature, BOD, dissolved oxygen, turbidity, alkalinity and coliform.

74. International Joint Commission. 1970. Special Report on potential oil pollution eutrophication and pollution from watercraft. Third Interim Report on Pollution of Lake Erie, Lake Ontario and the International Section of the St. Lawrence River. Washington and Ottawa. 36 p.

A table summarizing the input of total phosphorus to Lakes Erie and Ontario in 1967 is presented.

Fifty-seven percent of the total phosphorus supplied to Lake Ontario is attributable to municipal and industrial sources. The percentage of the total nitrogen input into the lake which is attributable to municipal and industrial sources is 30%.

75. International Lake Ontario - St. Lawrence River Water Pollution Board. 1969. Report to the International Joint Commission on the pollution of Lake Erie, Lake Ontario and the St. Lawrence River. 3: 61-122.

This section of the report provides a detailed description of the water chemistry of Lake Ontario. The chemistry is divided into five sections: (1) nutrient chemistry, (2) oxygen distribution and depletion, (3) major ions and trace elements, (4) other characteristics, (5) organic contaminants. Many graphs and charts are included.

76. Jackson, D. F., N. L. Nemerow and M. C. Rand. 1964. Ecological investigations of the Oswego River drainage basin. I. The outlet. Great Lakes Research Division, Univ. Michigan. 11: 88-99.

The Oswego River drainage, 5, 121 square miles, is the largest drainage area of the eastern part of Lake Ontario. In order to ascertain its effect on the lake, a series of sampling stations has been established at 10 different sites along contributing streams. This report represents the results obtained at Station 1, the outlet of the Oswego River into Lake ontario, from January 10 through March 6, 1964. Weekly average values for phosphates were 3.31 mg/l, total Kjeldahl nitrogen 2.06 mg/l, alkylbenzene-sulphonate, 0.16 mg/l. The average weekly pH value was 7.2 while the water temperature averaged 3°C, with a flow of 7.257 cfs. The average coliform count was 14,178 per 100 ml, the average weekly total phytoplankton value was 1,190 organisms per ml, while the zooplankton population, which consisted almost entirely of rotifers, averaged 4.4 per liter. The periphyton community consisted of 55 species representing 28 genera. The weekly average number of algal species growing on bricks in the river was 25. These had a volatile weight of 4.2 mg/l and consisted of 913/cm^2. The pollution load of the Oswego River was evaluated from information obtained through this study.

77. Jackson, D. F. 1966. Photosynthetic rates of *Cladophora fracta* from two sites in Lake Ontario under natural and laboratory conditions. Univ. Michigan, Great Lakes Research Division. 15: 44-50.

Photosynthetic and respiration rates of *Cladophora fracta* were measured under natural conditions in Lake Ontario at Oswego, N. Y. and in Henderson Bay during the months of June-July and September-October 1965. The average photosynthetic rate for the early summer months for Lake Ontario at Oswego was 2.63 while that of Henderson Bay was 2.35 ul O_2/hr/mg ash-free dry wt. The fall months average was 1.27 for Oswego and 0.50 ul O_2/hr/mg ash-free dry wt. for the Henderson Bay area. Respiration rates were slightly higher in Henderson Bay, both in the early summer and in the fall.

Cladophora samples to which specific quantities of the radio-nuclide P_{32} were added showed only a slight average increase in photosynthetic activity in samples collected in June and July from the Oswego site (0.17 ul O_2/hr/mg ash-free dry wt.). *Cladophora* samples collected in September and October and treated with P_{32} had an average increase of 1.04 ul O_2/hr/mg ash-free dry wt.

78. Jackson, D. F. 1967. Lake Ontario and the St. Lawrence River - What are their fates? Unpublished paper presented to the Cape Vincent Chamber of Commerce and the Cape Vincent Village Board, April 27, 1967. 7 p. + Appendix.

This paper presents data containing the minimum, average and maximum radioactivity expressed in pica-curie/g for eight species of fishes and for *Cladophora* collected from Lake Ontario near Oswego, New York in April, 1965.

A maximum radioactivity of 12.30 pica-curie/g was found in bluegills and the minimum of 0.26 pica-curie/g was found in the gizzard shad. *Cladophora* ranged from 21.12 to 79.14 pica-curie/g with an average of 58.13 pica-curie/g.

Johnson, M. G. - See: J. H. Neil, et.al., No. 111.

Johnson, M. G. - See: G. E. Owen, No. 129.

79. Johnson, M. G. and D. H. Matheson. 1968. Macroinvertebrate communities of the sediments of Hamilton Bay and adjacent Lake Ontario. Limnol. Oceanogr. 13(1): 99-111.

The distribution and abundance of benthic macroinvertebrates in Hamilton Bay and adjacent Lake Ontario were related to physical and chemical characteristics of the water and sediments and to hydrodynamic factors. The profundal sediments of Hamilton Bay, rich in organic matter, contained an abundance of *Limnodrilus hoffmeisteri* and *Tubifex tubifex*, while lesser numbers of five *Limnodrilus* species occupied poorer sublittoral sediments. No macroinvertebrate community occurred in sediments containing more than 25% Fe_2O_3. The combination of more favorable water chemistry, circulation and moderately rich sediments near the canal connecting the bay with Lake Ontario increased biomass of oligochaetes over that in the richer, profundal sediments of the main basin of the bay. In Lake Ontario the oligochaetes, *L. hoffmeisteri*, *T. tubifex* and *Stylodrilus heringianus* and the amphipod, *Pontoporeia affinis* increased in numbers with increasing depth and richness of sediments. Emissions of bay water to Lake Ontario clearly influenced the specific composition of macroinvertebrate communities. The community of several oligochaetes and *Chironomus attenuatus* found in the lake near the canal resembled the sublittoral bay community. *T. tubifex* occurred in the lake only in the plume of rich sediments projected into the lake from the canal, while sphaeriid populations were more abundant and contained more species in the sandy or loamy sediments outside the plume.

80. Johnson, M. G. and G. E. Owen. 1970. The role of nutrients and their budgets in the Bay of Quinte, Lake Ontario. Ontario Water Resources Commission, Ottawa. 28 p.

The Bay of Quinte shows symptoms of cultural eutrophication which are markedly similar to those of Lake Erie. Algal blooms are severe and prolonged and macroinvertebrate and fish communities are composed of pollution-tolerant species.

The bay received about 9,700,000 pounds of nitrogen and 700,000 pounds of phosphorus in 1968. Of these total inputs 89% of the nitrogen and 60% of the phosphorus were attributable to land drainage and the remainder of each nutrient to municipal-industrial sources.

Comparison of absolute inputs is shown to be ecologically unsound because low-volume high concentration inputs are compared directly with high-volume, low-concentration river inputs. Comparisons based on "net inputs" are proposed; "net input" is defined as the amount of nutrient contained in an input in excess of the amount of nutrient in the equivalent volume of water displaced at the outlet. In the Bay of Quinte about 50% of the "net input" of nitrogen and 85% of phosphorus were contributed by municipal-industrial sources in 1968.

Phosphorus removal from high-concentration, low-volume inputs i.e. municipal-industrial sources, is recommended. The high turnover rate of water in the bay, five times annually, should contribute towards improved water quality by translocating re-suspended nutrients from sediments in shallow water of the inner bay to sediments in deeper waters of the outer bay and Lake Ontario. The estimated cost of nutrient removal, 200,000 dollars per year, is apparently justified in view of the importance of the local tourist trade (about one million visitors in 1968 spent 7.8 million dollars) and its future viability in the face of deteriorating water quality conditions.

81. Johnson, M. G. and G. E. Owen. 1971. Nutrients and nutrient budgets in the Bay of Quinte, Lake Ontario. Journal Water Pollution Control Federation. 43(5): 836-853.

Algal blooms, turbidity, depletion of deep-water oxygen and changes in composition of the biota are increasingly obvious in Bay of Qunite, Lake Ontario. Clarification of respective significance of nutrient contributions from tributary rivers and from municipal-industrial sources are described. The bay received about 9,700,000 pounds of nitrogen and 700,000 pounds of phosphorus in 1968. 89% of the nitrogen and 60% of the phosphorus were attributable to land drainage and the remainder to municipal-industrial sources. Comparisons based on "net inputs", the amount of nutrient contained in an input in excess of the amount of nutrient in the equivalent volume of water displaced at the outlet, are proposed. About 50% of the "net input" of nitrogen and 85% of phosphorus were contributed by municipal-industrial sources in 1968. It is recommended that phosphorus be removed from these sources. The water turnover rate in the bay, five times annually, translocates resuspended nutrients in sediments of the inner bay shallow waters to sediments in deeper waters of the outer bay and Lake Ontario, thus improving water quality. Estimated phosphorus removal cost $200,000 dollars/yr. is justified on the basis of economics income from recreation and tourism.

Johnson, W. E. - See: J. R. Vallentyne, et.al., No. 177.

Johnson, W. L. - See: C. Henderson, et.al., No. 70.

Kemp, A. L. W. - See: C. B. J. Grey, No. 66.

Kemp, A. L. W. - See: R. L. Thomas, et.al., No. 153.

82. Kemp, A. L. W. and C. F. M. Lewis. 1968. A preliminary investigation of chlorophyll degradation products in the sediments of Lakes Erie and Ontario. Proceedings 11th Conference Great Lakes Research. pp. 206-229.

Thirty seven surface sediment samples from lakes Erie and Ontario have been examined for acetone-soluble chlorophyll degradation products, from stations generally distributed along the axis of the two lakes. Determinations were made for chlorophylls, pheophytins, organic carbon, carbonate carbon, Eh, pH and particle size distribution.

Sub-environments within each lake were recognized on the basis of bathymetry, sediment particle size distribution, clay mineral content and mud thickness. Total chlorophylls (chlorophylls a and b) ranged in concentration from 0 to 30 ppm dry weight of the sediment in the two lakes. Total pheophytin (pheophtins a and b) concentrations of 0 to 192 ppm dry weight of sediment were found, with the pheophytin concentrations along the axis of Lake Erie being generally greater than along the axis of Lake Ontario. Calculations showed that the phytoplankton chlorophylls are 93 to 100 percent decomposed before settling on the bottom. The pheophytins decomposed an average of 70 percent with curial in the sediment to a depth of 5 cm, whereas the organic carbon decomposed an average of 33 percent under the same conditions. Percent organic carbon ranged from 0.23 to 3.60 in Lake Erie sediment to 1.90 to 5.00 in Lake Ontario sediments. The pheophytin concentration paralleled the organic carbon content and both varied with the clay content of the sediments. The generally lower values of organic carbon in Lake Erie are attributed to dilution of the sediments with coarser non-clay particles.

83. Kemp. A. L. W. 1969. Organic matter in the sediments of Lakes Ontario and Erie. Proceedings 12th Conference Great Lakes Research. pp. 237-249.

Organic carbon and carbonate were determined in six piston cores from Lake Ontario and four piston cores from Lake Erie. The changes in organic carbon with depth of burial are related to sediment type and Eh.

The basin sediments of Lake Ontario consisted of black laminated grey silty clay muds overlying grey glacial clay, with mud thickness ranging from 4.6 to 13.8 m in the cores. Organic carbon content decreased 50% in the top 20 cm of sediment and then gradually decreased to 1% at the glacial clay contact. A complex organic carbon horizon was found two thirds of the way down the post glacial mud column at each core station and was attributed to a warmer climate between 4000 and 7500 years BP. Lake Erie main basin sediments consisted of a uniform grey silty clay mud with a similar decrease in organic carbon as in Lake Ontario. Penetration was less than two thirds of the post glacial mud column except in the Sandusky basin, where a higher organic carbon value obtained at the bottom of the core suggested an organic horizon in Lake Erie similar to that found in Lake Ontario. A core from the Western basin was typical of a small lake core with a high organic carbon content and plant detritus in the post glacial mud. Eh remained at about zero volts in the post glacial muds of both Lakes and increased to about 0.150 volt in the glacial clay. Carbonates generally showed an inverse relationship to the organic carbon, increasing to about 2% carbonate carbon in the post glacial muds.

Bitumens accounted for 3 to 6% of the organic matter, humic and fulvic acids for 19 to 27% and kerogen for 35 to 49% in the surface centimeter of sediment, in the main basins of the two lakes. The lower organic carbon content and the greater percent kerogen in the Lake Erie surface sediment were, in part, attributed to greater decomposition of the organic matter by bottom dwelling organisms.

84. Kemp, A. L. W. and A. Mudrochova. 1970. Extractable phosphates, nitrates and ammonia in Lake Ontario sediments. Unpublished paper presented at the 13th Conference on Great Lakes Research, Buffalo, New York, April 1-3, 1970.

Seventy-four surface sediment samples from Lake Ontario have been examined for extractable phosphates, nitrates and ammonia. The sample stations are generally on a 16 km grid and sub-samples were taken from the top centimeter (the oxidized zone) and between 4 to 6 km (the reduced zone). A core from the center of the lake was also examined. The phosphates, nitrates and ammonia were extracted in 0.05 N boric acid using an electrodialysis procedure.

Phosphates were found to range from 3 to 10 ug of P/gm dry weight of sediment (ug of P), nitrates from 0 to 19 ug of N and ammonia from 20 to 246 ug of N. In the nearshore sands, phosphates averaged 9 ug of P, nitrates 1 ug of N and ammonia 60 ug of N, while in the deeper water silty clay muds, phosphates average 17 ug of P, nitrates 0 ug of N and ammonia 95 ug of N. Glacial clay which underlies many of the nearshore stations and the cross lake ridges contained an average phosphate level of 92 ug of P. Samples were also taken in Hamilton Harbor and the Bay of Quinte where phosphates averaged 18 ug of P, nitrates 5 ug of N and ammonia 178 ug of N. In general, the concentration of phosphates and nitrates decreased with the depth of burial from the oxidized zone to the reduced zone whereas the ammonia concentration increased. The extractable phosphates were directly related to the organic matter content of the sediment, except in the glacial clay samples, suggesting that the phosphate concentration is generally related to the decay of organic detritus.

Analysis of a piston core from the center of Lake Ontario showed that the extractable phosphates, nitrates and ammonia had high concentrations in the post glacial muds and low concentrations in the underlying glacial clay.

85. Kemp, A. L. W., C. B. J. Grey and A. Mudrochova. 1971. Changes in C, N, P and S levels in Lakes Ontario, Erie and Huron sediments in the last 170 years. Unpublished paper presented at the 14th Conference on Great Lakes Research. April 19-21, 1971, Toronto.

Sediment cores were collected from close to the deepest point in Lake Ontario, the deepest area in the central basin of Lake Erie and from the deepest point in South Bay, Lake Huron. Sediment particle size, water content, pH, Eh, organic carbon, carbonate carbon, total nitrogen, total phosphorus and total sulphur were measured at 1 cm intervals down to 10 cm and then at increasing intervals to 50 cm.

86. Kemp, A. L. W. 1971. Organic carbon and nitrogen in the surface sediments of Lakes Ontario, Erie and Huron. Journal Sedimentary Petrology. 41 (2): 537-548.

Analyses of 355 surface sediment samples (top cm) from Lakes Ontario, Erie and Huron were carried out for organic carbon, carbonate carbon, Eh, pH, nitrogen and sediment texture. Similar analyses were carried out on a representative core from each lake at close intervals down to 20 cm. The distribution of organic matter in the sediments of each lake was related to the topographic features of the lakes. Organic carbon content was found to be directly proportional to the clay content of the sediment, ranging from less than 1 percent in the coarse nearshore sands to over 4 percent in the fine clay muds within the individual lake subbasins. The organic carbon content of Lake Erie sediments was generally lower than that of Lakes Huron and Ontario, and is attributed to dilution of the sediments with coarser non-clay particles. Nitrogen was directly proportional to organic carbon with carbon-nitrogen ratios ranging from 7 to 13 in the surface sediment. Organic carbon and nitrogen decreased sharply from the surface down to about 10 cm in each core. The decrease is due partly to mineralization of organic matter by bottom organisms and partly to an increasing input of organic matter to the lakes in the last 30 years.

87. Kindle, E. M. 1925. The bottom deposits of Lake Ontario. Proc. and Trans., Royal Society of Canada, 3rd Series. 19: 47-102.

Some chemical analysis data are given for limestone taken from the bottom of Lake Ontario.

88. Kopp, J. F. and R. C. Kroner. 1969. Trace metals in waters of the United States. Federal Water Pollution Control Administration, Cincinnati, Ohio. 32 p. + Appendix.

Tabulated data are presented for the surface waters of the Niagara River at Buffalo, New York and the St. Lawrence River at Massena, New York.

The water is analyzed for Zn, B, Fe, Mn, Cu, Ba, Sr, Cd, Al, Cr and other trace elements. The minimum, maximum and mean values in ug/l are given. The number of positive occurrences and the frequency of detection (in percent) are also included.

Kramer, J. R. - See: J. C. Sutherland, et.al., No. 144.

89. Kramer, J. R. 1962. Chemistry of western Lake Ontario. Great Lakes Research Division, Univ. Michigan. 9: 21-28.

Lake Ontario is of more uniform composition with respect to the major constituents than Lake Erie. The chemical processes going on in Lake Ontario are likewise simple. There is no detectable change in the composition of water in Lake Ontario "downstream"; only in the extreme western end was there detected a noticeable vertical change (decrease in Eh) with depth.

The major processes consist of saturation of calcium carbonate, development of an oxidizing (iron oxide) water environment, and development of a reducing (iron sulfide) sediment environment.

These conclusions are not based on the detailed sampling and analyses that were carried on for Lake Erie.

90. Kramer, J. R. 1964. Theoretical model for the chemical composition of fresh water with application to the Great Lakes. Great Lakes Research Division, Univ. Michigan. 11: 147-160.

Inorganic sediment-water equilibrium models are compared to the actual concentration of major constituents in the Great Lakes. 1) Lake Superior is unsaturated with respect to all constituents by a factor determined by the amount of rainfall on the lake divided by the total rainfall in the drainage basin. 2) Lakes Huron and Michigan are saturated with respect to all major constituents except sodium, silica and phosphorus. 3) Lakes Erie and Ontario are saturated with respect to all major constituents except silica and phosphorus.

4) Phosphorus is in excess in all lakes except Superior. Excess phosphorus is suggested as an empirical index of "biological activity." The problem of the apparent unsaturation of silica exists in all the Great Lakes. 5) Sulphate and chloride are not regulated by natural processes at present. The upper limit on sulphate concentration is determined by the saturation of $SrCO_3$-$SrSO_4$ (model 3). There is no natural control on chloride concentration relative to sediment-water equilibrium. 6) Increasing input of sulphur, particularly as sulphide, tends to make the lakes eutrophic.

91. Kramer, J. R. 1967a. Chemistry of Lakes Erie and Ontario assuming a Gibbsian thermodynamic world. In: Systems Approach to Water Quality in the Great Lakes. Proceedings 3rd Annual Symposium on Water Resources Research of the Ohio State University Water Resources Center, Columbus, Ohio. pp. 27-36.

Within the total inorganic-organic system, normally natural processes approach a reversible inorganic equilibrium state with respect to solids, liquids and gases. Equilibrium calculations are therefore a means to define a "norm" or water criteria standard. The measurements and calculations to define this norm are simple in most cases.

Deviations from the norm are influenced by complicated (and in most cases, unknown) organic processes as long as there is some equivalency between variables in the calculations of the norm and the complicated organic processes.

Engineering management may be undertaken by manipulating "simple" inorganic variables common to both inorganic and organic mechanisms. The manipulation of the variables should be considered first in an inorganic context.

92. Kramer, J. R. 1967b. Equilibrium models and composition of the Great Lakes. Advan. Chem. Ser. No. 67: American Chemical Society, Washington. pp. 243-254.

To a good first approximation, the Great Lakes fit a model involving the equilibrium of calcite, dolomite, apatite, kaolinity, gibbsite, Na- and K-feldspars at 5°C, 1 atm. total pressure with air of $P_{CO_2} = 3.5 \times 10^{-4}$ atm. and water. Dynamic models, considering carbon dioxide pressure and temperatures as variables (but gross concentrations fixed), show that cold waters contain excess carbon dioxide and are unsaturated withrespect to calcite, dolomite and apatite, whereas warm waters are nearly at equilibrium with the atmosphere but somewhat supersaturated with respect to calcite, dolomite and apatite.

93. Kramer, J. R. 1968. Mineral water chemistry, Great Lakes. Great Lakes Research Division, Univ. Michigan. Special Rept. No. 38. 59 p.

This report contains a computer program which uses major and minor ion concentration to determine the degree of saturation of lake water with respect to $CaCO_3$, $CaMg(CO_3)_2$, $Ca_{10}(PO_4)_6(OH)_2$, air and oxygen an and carbon dioxide and various aluminosilicates. Water sample analysis data for two cruises on Lake Ontario are evaluated with this program. The parameters measured are temperature, specific conductance, pH, alkalinity, dissolved oxygen, silica, orthophosphates, chlorides, sulfate, sodium, calcium, potassium, magnesium and floride.

Krammerer, J. C. - See: B. K. Gilbert, No. 61.

Kroner, R. C. - See: J. F. Kopp, No. 88.

Kurtz, T. D. - See: J. C. Sutherland, et.al., No. 144.

94. Lake Erie-Lake Ontario Advisory Board. 1967. Summary Report on pollution of the Niagara River to the International Joint Commission on Control of Pollution of Boundary Waters, Washington. 43 p.

Describes type and amount of pollution from various municipal and industrial sources that discharge into the Niagara River.

Phenol concentrations and coliform densities are given for various points on the river.

95. Lake Erie-Lake Ontario Advisory Board. 1971. Pollution abatement progress in the Niagara River area. Summary report to the International Joint Commission on Control of Pollution of Boundary Waters, Washington. 62 p.

This report is a summary of the pollution abatement progress that has occured since 1967. Contains some data on water quality.

96. Lerman, A. and R. R. Weiler. 1970. Diffusion and accumulation of chloride and sodium in Lake Ontario sediment. Earth and Planetary Sci. Letters. 10: 150-156.

Distribution of Na+ and Cl- in the upper 30 cm of Lake Ontario sediment cores indicates that the two species are being transferred from the lake water into the sediment. The likely cause of the transfer is the strong increase in their concentrations in the lake during the 20th century. The concentration data are compatible with diffusional transport models which lead to following estimated values of the diffusion coefficients in the sediment-pore water column. $D_{Cl} = 2 \times 10^{-5} - 3 \times 10^{-5}$ cm^2.sec^{-1} and D_{Na} + $3 \times 10^{-6} - 4 \times 10^{-6}$ cm^2. sec^{-1}. The diffusion coefficient of Na+ in pore water, corrected for the uptake of Na+ by the sediment, is $D'_{Na} = 9 \times 10^{-6} - 1.2 \times 10^{-5}$ cm^2. sec^{-1}. The total amount of each species which has entered and accumulated in the sediment-pore water column since the concentrations in the lake began to rise is, for Cl-, 2.96 mg.cm^{-2} and, for Na+, 1.31 mg.cm^{-2}. The amounts accumulated in the sediment are on the order of only 1-2% of the amounts of the two species now present in the lake water.

97. Leverin, H. A. 1947. Industrial waters of Canada-report on investigations. 1934-1943. Canadian Dept. of Mines and Resources Rept. No. 819. 109 p.

Tabulated data for the surface water of Lake Ontario taken from civic water supply intakes are presented on: color, alkalinity, dissolved solids, Fe, Ca, Mg, HCO_3, SO_4, Cl, NO_3 and hardness. Descriptive statements are made giving sampling data and location and method of purification. (Univ. of Toronto - Zoology).

Lewis, C. F. M. - See: A. L. W. Kemp, No. 82.

Lewis, C. F. M. - See: R. L. Thomas, et.al., No. 153.

98. Lewis, C. F. M. and R. N. McNeely. 1967. Survey of Lake Ontario bottom deposits. Proceedings 10th Conference Great Lakes Research. pp. 133-142.

Short gravity cores and grab samples, recovered during a continuing reconnaissance survey initiated in 1966, were used to study the distribution, stratigraphy and chronology of Lake Ontario bottom deposits. Three major groups of surficial deposits were recognized: (1) complex nearshore sediments, (2) glaciolacustrine clays and (3) postglacial muds. Organic contents of 2 to 6 percent and median particle diameters of 1 to 4 microns are typical of the offshore surficial muds. Pollen in these sediments facilitates correlation and subdivision and indicates that the present sedimentation rate in the main basin is approximately 10 cm per century. Several sediment sequences confirm the postglacial low-level Admiralty Lake stage and suggest it may have reached lower levels than previously believed.

Lipton, S. D. - See: R. C. Bubeck, et.al., No. 18, 19.

Lichtenberg, J. J. - See: L. Weaver, et.al., No. 181.

Loucks, R. H. - See: M. A. Tiffany, et.al., No. 156.

Marin, L. - See: C. Nalewajko, No. 110.

Matheson, D. H. - See: D. V. Anderson, No. 3.

Matheson, D. H. - See: M. G. Johnson, No. 79.

99. Matheson, D. H. 1958. A consolidated report on Burlington Bay. Corp. City of Hamilton. Hamilton, Ontario, 1958. Unnumbered.

This report is a summary of the results of surveys of the condition of Burlington Bay which have been made over the past quarter-century. The scope of the surveys varied from year to year as different aspects of the problem were studied. In the latter years, more attention was paid to detailed chemical analyses. In 1958 a program of radioactivity measurements was begun to determine the natural radioactivity background. Other parameters are: nutrients, major ions, temperature, dissolved oxygen, pH, alkalinity, carbon dioxide, hardness, turbidity and chlorine.

100. Matheson, D. H. 1962. A pollution study of western Lake Ontario. Great Lakes Research Division, Univ. Michigan. 9: 15-20.

Three tracers were used to study the emission and distribution of polluted water from Hamilton Bay into Lake Ontario. Ammonia, which was rapidly dissipated in the lake due to metabolic consumption and dilution, showed a pattern of recent emissions. Coliform bacteria, because of their large numbers and the sensitivity of the test, showed a more complicated pattern which included the effects of previous emissions. Synthetic detergent materials, which are chemically and biologically stable, showed the presence of still older emissions from which the previous two indicators had disappeared.

101. Matheson, D. H. 1963. A sanitary study of the western end of Lake Ontario in connection with the locating of new water works intakes for the City of Hamilton 1961-62. Dept. of Municipal Labs, Corp. of the City of Hamilton. Hamilton, Ontario. Unnumbered.

In order to evaluate the degree of pollution existing on different areas of the lake, two well recognized indicators were chosen, namely coliform concentrations and organic and inorganic nitrogen (albuminoid and free ammonia).

In addition to these, other substances were measured which might serve as useful identifying markers of Bay water in the lake, and so permit the tracing of bodies of Bay water as it is distributed in and mixed with the lake water. These determinations included - syndet, phenols, silica, alkalinity and hardness. The practical value of these different "tracers" is discussed.

102. Matheson, D. H. and D. V. Anderson. 1965. Circulation and water quality of Western Lake Ontario. Research Rept. No. 62, Ontario Dept. Lands and Forest. 36 p.

In designing water intakes from lakes and associated treatment plants, a knowledge of the character of the water is useful. This is especially true where lake waters are liable to pollution and where there are wide daily and monthly variations in physical characteristics. In preparation for a new intake at Hamilton, Ontario, surveys were conducted in 1960 of the waters in the lake nearby. Measurements of circulation, temperature and of various chemical constituents made in these surveys are reported here.

103. Matheson, D. H. and D. V. Anderson. 1966. The temporal distribution of chlorophyll in Lake Ontario at Hamilton, Ontario. Proceedings 9th Conference Great Lakes Research. pp. 90-97.

Municipal water intakes are convenient means of sampling lake water for research purposes. Since certain constituents such as ammonia, E. coli, pH, alkalinity and hardness must be measured for quality control, the data on their concentrations are freely available to characterize lake water processes. One constituent, chlorophyll, is especially important in assessing productivity of a lake. As three years of records on chlorophyll densities are available at Hamilton, it was thought worthwhile to summarize them, especially as so few similar studies have been made in the Great Lakes. Few conclusions are warranted from one sample location for lakewide conditions. However, since chlorophyll is easy to measure, and its presence is argued to give a powerful average representation of photosynthetic processes, it is suggested that assessment of chlorophyll be included in all routine biochemical sampling stations throughout the Great Lakes.

104. Mattingly, A. L. 1961. Chemical and Physical Quality of Water Resources in the St. Lawrence River Basin New York State (1955-1956). Progress Report. New York State Dept. of Commerce and the Geological Survey, U. S. Dept. of Interior, Albany, New York. Bulletin No. 4. 96 p.

The chemical quality of the ground water and of the following major streams in the St. Lawrence River basin is discussed in this report: Black River at Watertown, Oswegatchie River at Heuvelton, Grass River at Pyrites and St. Lawrence River at Ogdensburg. Tables and illustrations supplement the discussion.

The chemical quality of water from most streams in the area is satisfactory for multiple uses but not necessarily for all uses. Iron concentrations in water from a few streams could be a problem. Generally, the hardness of water would present no problem.

105. McCombie, A. M. 1967a. A recent study of the phytoplankton of the Bay of Quinte 1963-1964. Proc. 10th Conference Great Lakes Research. pp. 37-62.

This study was undertaken to assess the quality and the quantity of phytoplankton in different parts of the Bay of Quinte and compare present conditions at the mouth of that bay with those found there by Allan Tucker in 1945. Samples were collected from the inner, middle and outer bay and from the mouth of the Trent Canal, its main tributary.

Phytoplankton concentrations in the inner bay were about 10 times those in the middle bay and 100 times those at the mouth. Concentrations in the Trent Canal were similar to those at the bay mouth. Supersaturation of surface waters with dissolved oxygen and low Secchi disc readings in the inner and middle bay at times in 1963 and 1964.

Diatoms and bluegreen algae dominated the counts in all 3 years while greens and other classes amounted to less than 10%. There was no definite evidence of an increase in the phytoplankton concentrations at the bay mouth since 1945. However, the diatoms *Tabellaria* and *Fragilaria* comprised a smaller fraction of the plankton there in 1963 and 1964 than in 1945 while blooms of bluegreen *Aphanezomenon* began a month earlier in the later years.

Relations between the morphometric and edaphic conditions and the phytoplankton concentrations are discussed and possible effects of artificial enrichment considered. Some effects of currents on the phytoplankton distribution are also noted.

106. McCombie, A. M. 1967b. Some physical and chemical characteristics of the Bay of Quinte. Research Rept. No. 79. Ontario Dept. Lands and Forest. 56 p.

The Research Branch of the Ontario Department of Lands and Forests undertook to study certain aspects of the physics, chemistry and phytoplankton of the bay during the summers of 1963 and 1964 in order to compare present conditions with those reported in earlier investigations. As part of this study, two synoptic surveys were carried out on June 23 and August 25, 1964 to determine the coliform counts, total alkalinities, water temperature, specific conductivities and the concentrations of total phosphorus, dissolved phsophorus, Kjeldahl nitrogen, ammonia nitrogen, iron, chlorides and phenols in different parts of the bay.

McNaught, D. C. - See: M. W. Fenlon, et.al., No. 58.

McNeely, R. N. - See: C. F. M. Lewis, No. 98.

107. Meloon, D. T. and R. Yalkovsky. 1970. Metal ion content of Niagara River water. Proceedings 13th Conference Great Lakes Research. pp. 683-692.

Analysis of 180 Niagara River shallow water samples has been undertaken by atomic absorption spectrophotometry and by flame photometry. Laboratory procedures were developed for analyzing sodium, potassium, calcium and magnesium and for overcoming chemical interferences. The concentration levels found for these elements suggest the presence of industrial and municipal contamination. Sodium concentrations were in the range 10 to 30 ppm, potassium in the range 1.2 to 4.0 ppm, calcium in the range 30 to 60 ppm and magnesium in the range 7.3 to 12.0 ppm.

108. Meloon, D. T., R. Yalkovsky and J. Norton. 1971. Metals as indicators of paracontamination in upper Niagara River shoal waters. Abstract of papers presented at 14th Conference on Great Lakes Research, Toronto. pp. 142-143.

Shoal water was collected at fifty-five sampling sites in the upper Niagara River between October 30 and December 1, 1970 and analyzed for sodium, potassium, calcium and magnesium. The purposes of such analyses were to determine if these metals could be used as indicators of paracontamination and to determine if significant changes in concentrations of these 4 metal ions have occurred since a similar study conducted during fall 1969.

Mudrochova, A. - See: A. L. W. Kemp, No. 84.

Mudrochova, A. - See: A. L. W. Kemp, et.al., No. 85.

Mueller, J. A. - See: D. J. O'Connor, No. 121.

Nair, J. H. - See: G. Zweig, et.al., No. 186.

109. Nalewaiko, C. 1966. Photosynthesis and excretion in various planktonic algae. Limnol. Oceanogr. 11(1): 1-10.

Twenty-four species of planktonic algae, including 16 Chlorophyceae, seven Bacillariphyceae and one Cyanophyceae, were found to liberate a part of their photosynthetic products into the medium. This excretion was less than 2% of the total carbon fixed during photosynthesis in short-term experiments with dilute cell suspensions under conditions of abundant CO_2 supply and limiting or saturating light intensities.

Excretion was increased at high population density, under conditions of limiting levels and at light intensities sufficient to inhibit photosynthesis.

Excretion values in *Chlorella pyrenoidosa* Chick. were usually lower than in other species under the same environmental conditions.

110. Nalewajko, C. and L. Marin. 1968. Extracellular production in relation to growth of four planktonic algae and of phytoplankton populations from Lake Ontario. Can. Journal of Botany. 47: 405-413.

In four species of planktonic algae both carbon fixation and excretion on an ash-free dry weight basis increase with relative growth rate (K) of the culture measured in $\log_{10}$ units. In natural populations percentage excretion values are positively correlated with K values; however, environmental factors may be of relatively greater importance and determine the extent of excretion.

111. Neil, J. H., M. G. Johnson and G. E. Owen. 1967. Yields and cources of nitrogen from several Lake Ontario watersheds. Proceedings 10th Conference Great Lakes Research. pp. 375-381.

The yield of nitrogen was estimated from six selected southern Ontario watersheds representing rural and urban land uses. A discharge total nitrogen rating curve was calculated and applied to the hydrograph of each watershed to develop these estimates. Total annual yield of nitrogen was found to be 3,200 lbs. N/mi^2/yr. for rural watersheds and 34,000 lbs. N/mi^2/yr. for urban watersheds when effluents from secondary treatment plants were included. The nitrogen yield from rural watersheds during February, March and April constituted 58% to 69% of the annual contribution, whereas the yields from urban watersheds were uniformly high. Yields calculated from concentration of phosphorus found in the same samples indicated a ratio of nitrogen to phosphorus (PO_4) of 1.5 to 1 for urban watersheds and 8 to 1 for rural watersheds. The percent reduction in gross yield that might be expected to be achieved through complete removal of nitrogen at a sewage treatment plant was found to be 87%, based on the data obtained from one well-serviced, urbanized watershed.

Nemerow, N. L. - See: D. F. Jackson, et.al., No. 76.

112. New York State Department of Environmental Conservation. 1971. Periodic report of the water quality surveillance network 1965 thru 1967 water years. NYS Dept. Environmental Conservation, Albany, New York. 390 p.

Tabulated data for the surface water of Lake Ontario for the year 1965-67 are presented on: Ca, Na, K, Mg, alkalinity, SO_4, Cl, conductance, dissolved O_2, turbidity, total N_2, total PO_4, NO_3-N_2, NH_3-N_2, silica, pH, Mn, Fe, pesticides, hardness, phenols, dissolved solids, coliform count, CO_2 and temperature.

113. New York State Department of Health. 1953. Black River drainage basin. Lake Ontario Drainage Basin Survey Series Rept. No. 21. NYS Dept. Health, Albany, New York. 197 p.

Water quality data are tabulated for water samples collected at various points along the Black River.

The parameters measured include color, odor, BOD, turbidity, suspended matter, temperature, pH, dissolved oxygen, alkalinity and coliforms.

114. New York State Department of Health. 1957. Eighteen Mile Creek drainage basin and other tributaries entering Lake Ontario between Niagara River and Eighteen Mile Creek. Lake Ontario Drainage Basin Survey Series Rept. No. 3. NYS Dept. Health, Albany, New York. 71 p.

Chemical analysis data of water samples collected by the health department at streams tributary to Lake Ontario are tabulated.

115. New York State Department of Health. 1958. Lake Ontario surface water including specified tributaries. Lake Ontario Drainage Basin Survey Series Rept. No. 4. NYS Dept. Health, Albany, New York. 447 p.

Report contains a collection of physical and chemical data on Lake Ontario and its tributaries. Many tables and charts are included.

116. New York State Department of Health. 1959. Classifications and standards of quality and purity for fresh surface waters of the Lake Ontario Drainage Basin. Water Pollution Control Board, New York State Dept. Health, Albany, New York. 135 p.

Surface waters of the Lake Ontario drainage basin are classified according to the classes established by "Rules and Classifications and Standards of Quality and Purity for Waters of New York State," adopted by the New York State Water Pollution Control Board, effective October 25, 1950, amended April 30, 1959, and filed in the Office of the Secretary of State of the State of New York.

117. New York State Department of Health. 1961. Upper Genesee River Drainage Basin. Genesee River Drainage Basin Survey Series Report No. 2. NYS Dept. Health, Albany, New York. 219 p.

Chemical analysis data of water samples collected by the health department on streams tributary to Lake Ontario are tabulated.

118. New York State Department of Health. 1963. Evaluation of the extent and nature of pesticide and detergent involvement in surface waters of a selected watershed. Research Report 10(1). NYS Dept. of Health, Albany, New York. 74 p.

The surface water of the Wolcott Creek drainage basin was analyzed for the presence of detergents and various pesticides.

The alkylbenzenesulfonates were analyzed colorimetrically, the chlorinated hydrocarbon pesticides by gas-liquid chromatography with an electron capture detector and the m-dinitrobenzene compounds colorimetrically.

The results showed that aldrin, dieldrin, DDT and lindane were present in most water samples, although usually in concentrations of 1 ppb or less. DDT concentrations were highest of the pesticides reported followed by dieldrin, lindane and aldrin in that order.

The concentration of detergent was found to be much higher immediately downstream from the village of Wolcott and became more diluted further downstream. The amount of detergent upstream was small but measurable.

119. New York State Department of Health. 1965. Periodic Report of the water quality surveillance network 1960 thru 1964. NYS Dept. Health, Albany, New York. 135 p.

Tabulated data for the surface water of Lake Ontario for the years 1960 to 64 are presented on: Ca, Na, K, Mg, alkalinity, SO_4, Cl, conductance, dissolved O_2, silica, pH, Mn, Fe, pesticides, hardness, phenols, turbidity, total N_2, total PO_4, NO_3-N_2, NH_3-N_2, CO_2, dissolved solids, coliform count and temperature.

The data were collected at four points on the Lake: two near Rochester, one at Oswego and one near Fort Niagara, New York.

New York State Department of Health - See: Federal Water Pollution Control Administration, No. 56, 57.

Nichols, Lee - See: J. C. Sutherland, et.al., No. 144.

Nicholson, H. F. - See: Y. K. Chau, et.al., No. 41.

120. Nicholson, H. F. 1970. The chlorophyll a content of the surface waters of Lake Ontario, June to November, 1967. Fish. Research Board of Canada Tech. Rept. No. 186. 33 p.

This report presents the distribution of surface chlorophyll a as determined by a continuous fluorometer on eleven (11) cruises on Lake Ontario from June 12 to November 2, 1967. The highest lake mean concentration, 20.3 mg/m^3, occurred during June 12-17, followed by a rapid decline to the lowest lake mean concentration of 3.7 mg/m^3 between June 28 and July 10. Thereafter, the mean lake surface concentration varied between 3.8 and 8.4 mgCa/m^3.

Norton, J. - See: D. T. Meloon, et.al., No. 108.

121. O'Connor, D. J. and J. A. Mueller. 1970. A water quality model of chlorides in Great Lakes. Journ. of the Sanitary Engineering Div., Proceedings American Society Civil Engineers, Vol. 96, No. SA4: 955-975.

The increase in the concentration of conservative substances in the Great Lakes is described by a simple time variable equation. The concentration of chlorides is related to the fresh water flow, the volumes of the lakes and the various sources-municipal, industrial, natural background and road de-icing. The increase in concentration since 1900 is presented and projections are made of anticipated concentrations based on various assumptions of control.

122. O'Neill, R. D. 1964. Exotic chemicals. New York State Department Health. Proceedings 1st Annual Water Quality Research Symposium. pp. 60-79.

The surface water of the Wolcott Creek drainage basin was analyzed for the presence of detergents and various pesticides.

The alkylbenzenesulfonates were analyzed colorimetrically, the chlorinated hydrocarbon pesticides by gas-liquid chromatography with an electron capture detector and the m-dinitrobenzene compounds colorimetrically.

The results showed that aldrin, dieldrin, DDT and lindane were present in most water samples, although usually in concentrations of 1 ppb or less. DDT concentrations were highest of the pesticides reported followed by dieldrin, lindane and aldrin in that order.

The concentration of detergent was found to be much higher immediately downstream from the village of Wolcott and became more diluted further downstream. The amount of detergent upstream was small but measurable.

123. Ontario Water Resources Commission. 1962. Report on the Lakefront Survey of Water Quality, Waste Drainage Inlets of Lake Ontario within the Area-Town of Burlington to Scarborough Township Inclusive. Ontario Water Resources Commission, Ottawa. 142 p.

Tabulated data on the surface water of Lake Ontario along the shoreline from Toronto to Scarborough on: BOD, coliform count, total, dissolved and suspended solids, turbidity, phenols, ether solubles, pH, Cr, Cu, Cl, total and soluble PO_4, NH_3-N_2 and total Kjeldahl N_2. Descriptive statements are included which give the sampling location and date.

124. Ontario Water Resources Commission. 1965a. Water quality survey of the St. Lawrence River from Quebec Boundary to Kingston, 1962 to 1965. Ontario Water Resources Commission, Division of Sanitary Engineering, Ottawa. Unnumbered.

Tabulated data for the surface waters of the St. Lawrence River from Quebec boundary to Kingston are presented in three tables.

Contains data on coliform count, BOD, total, suspended and dissolved solids, turbidity, dissolved O_2 and temperature. Descriptive statements are also included which give location and date of sampling.

The parameters include: ammonia N_2, Kjeldahl N_2, NO_2, NO_3 and total and soluble PO_4. Again, location and date of sampling are given.

The third table presents data collected at the water intakes for the cities of Kingston, Augusta and Cornwall on hardness, alkalinity, Fe, Cl, pH, color and turbidity.

125. Ontario Water Resources Commission. 1965b. Report on a Water Quality Survey of Lake Ontario from Toronto to Kingston, 1962 - 1965. Ontario Water Resources Commission, Division of Sanitary Engineering, Ottawa. 15 p + Appendices.

Contains data for the surface water of Lake Ontario along the shoreline from Toronto to Kingston: coliform count, BOD, total, dissolved and suspended solids, turbidity, dissolved O_2 and temperature. Descriptive statements are also included which give the data and location of sampling.

The parameters included in Table II are: ammonia N_2, total Kjeldahl N_2, NO_2, NO_3 and total and soluble PO_4.

Contains data obtained at the Oshawa, Belleville and Kingston water works on: hardness, alkalinity, Fe, Cl, pH, color and turbidity.

126. Ontario Water Resources Commission. 1965c. Report on a study of Water Quality and Pollution Control - Metropolitan Toronto including the municipalities of Long Branch, New Toronto, Mimico, Etobicoke, Toronto and Scarborough along Lake Ontario. Ontario Water Resources Commission, Division of Sanitary Engineering, Ottawa. 104 p.

Tabulated data are presented for the surface water of Lake Ontario along the metropolitan Toronto shore line including Toronto Harbor on: BOD, suspended solids, phenols, coliform count and turbidity. Descriptive statements are included which give sampling location, date and map coordinates. Also included is a summary of the yearly data collected by the water supply division of the metropolitan Toronto Department of Works on coliform counts, free ammonia and phenols in the raw water from Toronto intakes.

127. Ontario Water Resources Commission. 1967. Water quality data 1964-1965. Volume 1. Ontario Water Resources Commission, Ottawa. 287 p.

Tabulated data for the surface water of Lake Ontario at various points along the Canadian shore are presented on: alkalinity, Cl, conductance, P, NO_3, pH, NO_2-N_2, hardness, phenols, turbidity, Fe, NH_3-N_2, dissolved solids, Kjeldahl-N_2, BOD, coliform count, temperature, synthetic detergents, NO_3-N_2, soluble P and dissolved O_2.

128. Ontario Water Resources Commission. 1969. Water quality data for Ontario lakes and streams, 1965-1966. Volume 2, Ontario Water Resources Commission, Ottawa. 364 p.

Tabulated data for the surface water of Lake Ontario at various points along the Canadian shore are presented on: coliform count, alkalinity, synthetic detergents, BOD, COD, Cl, Cr, conductivity, Cu, Cn, dissolved O_2, ether solubles, F. hardness, Fe, Pb, Ni, NH_3-N_2, Kjeldahl N_2, NO_2-N_2, NO_3-N_2, pH, phenols, total and soluble PO_4, suspended and dissolved solids, SO_4, turbidity and Zn.

Orban, E. - See: W. L. Tressler, et.al., No. 159.

Owen, G. E. - See: M. G. Johnson, No. 80, 81.

Owen, G. E. - See: J. H. Neil, et.al., No. 111.

129. Owen, G. E. and M. G. Johnson. 1966. Significance of some factors affecting yields of phosphorus from several Lake Ontario watersheds. Great Lakes Research Division, Univ. Michigan. 15: 400-410.

The significance of land use and physiography in determining the levels of total phosphorus in the six major watersheds of the Metropolitan Toronto region was examined. The annual yield of phosphorus from six selected subwatersheds of widely different land use was estimated. A discharge-total phosphorus rating curve was calculated and applied to the hydrograph of each subwatershed to develop these estimates. Annual yields of phosphorus varied between 300 pounds per square mile from a heavily urbanized area. Data from one well-serviced urbanized watershed indicated that approximately 90% of the yield of phosphorus was directed through the treatment facility.

130. Pauszek, F. H. 1959. Chemical quality of surface waters in the Allegheny, Genesee and Susquehanna River basins, New York, 1953-1956. NYS Dept. of Commerce and Geological Survey, U. S. Dept. Interior, Albany, New York. 94 p.

The chemical quality of the Genesee River deteriorates as it flows across the state. Polluting substances and mineral matter in ground water drained from beds of limestone, dolomite, gypsium and salt increase the concentration of dissolved solids and hardness.

On the basis of mineral content, water from the Genesee River at Scio, New York and Mt. Morris would be satisfactory or could be made satisfactory for many uses including public water supply. At Rochester, New York water from the Genesee River would have to undergo extensive treatment to reduce hardness.

Water sample analysis data are included. The parameters measured include silica, iron, calcium, sodium, magnesium, potassium, bicarbonate ion, chlorides, florides, nitrate, dissolved solids, hardness, specific conductance, pH, color and oxygen consumed. Descriptive statements are made for each sampling station which include the data and the sample location.

Powers, C. F. - See: A. Robertson, No. 135.

Rand, M. C. - See: D. F. Jackson, et.al., No. 76.

131. Reinert, R. E. 1970a. Summary of available information from Bureau of Commercial Fisheries Ann Arbor Biological Laboratory on pesticide levels in great lakes fish. Unpublished report of the Bureau of Commercial Fisheries Biological Laboratory, Ann Arbor, Michigan. 37 p.

Concentrations of DDT (DDT, DDE, DDD) and dieldrin in Lake Ontario fish are tabulated.

132. Reinert, R. E. 1970b. Pesticide concentrations in Great Lakes fish. Pesticides Monitoring Journal. 3(4): 233-240.

During the past 4 years, the Ann Arbor Great Lakes Fishery Lab of the Bureau of Commercial Fisheries has been monitoring insecticide levels in fish from the Great Lakes. The two insecticides found in all Great Lakes fish have been DDT (DDT, DDD, DDE) and dieldrin. Fish from Lake Michigan contain from 2 to 7 times as much of these insecticides as those from the other Great Lakes. Insecticide levels calculated on a whole-fish basis show a marked difference from species to species. Within a species, there is also an increase in DDT and dieldrin levels with an increase in size. If these insecticide levels are, however, calculated as ppm of insecticide in the extractable fish oil, the difference in concentration between species and the difference between size groups becomes considerably less. Laboratory experiments indicate that fish can build up concentrations of DDT and dieldrin at the parts per million level from the parts per trillion concentrations in the water.

133. Rizivi, S. S. A. and S. E. Salbach. 1968a. The yield of phosphorus in eastern Lake Ontario region. Ontario Water Resources Commission, Ottawa. 25 p.

The yields of phosphorus were estimated from four selected Eastern Lake Ontario region watersheds. These streams drain mainly agriculture and pasture lands to Lake Ontario. The variation of concentrations, flows and yields for the four watersheds were calculated and plotted for comparison on a monthly basis over the four year study period. Mathematical equations for forecasting of concentration levels were developed and tested for statistical significance. The mean monthly yields were also plotted to assess on a quantitative basis during the calendar year, the variation of the discharge of phosphorus to Lake Ontario. About 40 to 50 percent of the annual yields were found to be released during the months of February, March and April. A step-wise regression analysis was used for developing the relationship between concentration, yield and land use for this region. Three year annual yields of phosphorus from the four watersheds ranged between 237 to 810 lbs/mi^2-yr. The methodology presented could be used on other water quality data.

134. Rizivi, S. S. A. and S. E. Salbach. 1968b. The yield of nitrogen in eastern Lake Ontario region. Ontario Water Resources Commission, Ottawa. 26 p.

This report presents the nutrient concentrations and quantities in the waters flowing to Lake Ontario from four basins in the eastern Lake Ontario region. The sources which are believed to be primarily responsible for nutrient levels in these four basins, as well as the yearly yields discharged to Lake Ontario are presented. The four basins drain primarily rural (pasture and forest) land. A stepwise regression analyses was used to develop a relationship between concentration yield and land use for this region. An attempt to correlate streamflow and total nitrogen concentration was unsuccessful. Average annual yields of nitrogen were noticed in the range of 1,652 - 2,721 lbs/mi^2-yr. About 45 to 57 percent of the annual yields were found to be released during the months of February, March and April. Yields calculated from concentrations of phosphorus found in the same samples indicated a ratio of nitrogen to phosphorus(PO_4) of 8:1. Mathematical equations forecasting concentrations levels were developed and were tested statistically. These test showed no statistical significance.

135. Robertson, A. and C. F. Powers. 1967. Comparison of the distribution of organic matter in the five Great Lakes. In: Studies on the environment and eutrophication of Lake Michigan, Univ. Michigan Great Lakes Research Division Special Report No. 30. 258 p.

The five St. Lawrence Great Lakes are compared with regard to the relative amounts of organic matter. Particulate and dissolved organic matter were measured in all the lakes and the biomass of zooplankton and macrobenthos measured in the upper three lakes only. The study reveals that, in general, the lakes can be arranged in the order, Superior, Huron, Michigan, Erie, Ontario, with regard to increasing amounts of organic matter in the different categories. This does not seem to hold for the zooplankton. The order of ranking is closely related to the relative concentrations of total dissolved solids in the different lakes and may well be related to their relative states of eutrophication. The amount of dissolved organic matter is shown to be 3 to 10 times larger than the amount of particulate organic matter which, in turn, is much greater than the amount of zooplankton and macrobenthos.

136. Rodgers, G. K. 1962. Lake Ontario report, 1961. Univ. Toronto, Great Lakes Institute. Preliminary Rept. 7. 102 p.

Chemical analysis data of water samples collected during cruises on Lake Ontario in 1961 by the research vessel Porte Dauphine are tabulated.

The following cruises contain chemical data: 0-61-02, 0-61-03, 0-61-04, 0-61-05, 0-61-08 and 0-61-10.

The parameters measured include: specific conductance, dissolved O_2, pH, color.and temperature.

137. Rodgers, G. K. 1963. Lake Ontario data report, 1960. Univ. Toronto, Great Lakes Institute. Preliminary Rept. 10. 192 p.

Chemical analysis data of water samples collected during synoptic cruises on Lake Ontario in 1960 by the research vessel Porte Dauphine are tabulated.

The following cruises contain chemical data: 0-60-15, 0-60-16, 0-60-17, 0-60-18, 0-60-21, 0-60-22 and 0-60-23.

The parameters measured include: specific conductance, dissolved O_2, pH, color, coliform count and temperature.

Saitoh, H. - See: Y. K. Chau, No. 40.

Salbach, S. E. - See: S. S. A. Rizivi, No. 133, 134.

138. Saunders, G. W. 1964. Studies of primary productivity in the Great Lakes. Great Lakes Research Division, Univ. Michigan. 11: 122-129.

Data concerning photosynthesis in the Great Lakes are very scanty. There have been only two research programs which have dealt directly with photosynthesis in the Great Lakes. One of these programs attempted to gain some insight as to the distribution of photosynthesis in western Lake Erie. The other program attempted to develop and evaluate a shipboard method for estimating photosynthesis. Some additional inference concerning photosynthesis can be made using known concentrations of chlorophyll in Lakes Superior, Michigan Erie and Ontario. No data are available for Lake Huron. The assumptions made using chlorophyll to calculate photosynthesis are very broad and therefore interpretation is somewhat tenuous. When results for calculated photosynthesis using all methods are compared, two points are apparent: 1) the range of photosynthetic activity in all lakes is very large and 2) western Lake Erie is very different from the other Great Lakes It is more productive than many smaller lakes which ar considered to be highly productive.

The Great Lakes are important as a natural resource and as basins in which controlled experiments can be performed. Perhaps the very paucity of data indicates the exciting future which lies ahead for those individuals who study photosynthesis and other biotic events in these large lakes.

139. Schenk, C. F. and R. E. Thompson. 1965. Long term changes in water chemistry and abundance of plankton at a single sampling location in Lake Ontario. Great Lakes Research Division, Univ. Michigan. 13: 197-208.

Evaluation of data accumulated at the Toronto Island Filtration Plant from 1923 to 1954 that the level of plankton approximately doubled during this period. Coincidentally, increasing levels of free ammonia, chlorides, hardness and turbidity were experienced and these continued to increase up to 1964. Turbidit levels and concentrations of free ammonia in the "ra water were substantially greater than results obtained farther out in the lake. The mean increase of plankton was computed at 5.6 areal standard units per annum. Well-defined spring maxima and winter minimum populations were apparent nearly every year, but fall maxima developed inconsistently and were characterized by lower levels of abundance than the spring pulses.

Schroder, G. D. - See: M. W. Fenlon, et.al., No. 58.

140. Shiomi, M. T. and V. K. Chawla. 1970. Nutrients in Lake Ontario. Proceedings 13th Conference Great Lakes Research. pp. 715-732.

Nutrient data were collected at monthly intervals on 60 stations in Lake Ontario during the period April 1969 to March 1970. They were analysed to determine mean concentrations and to investigate horizontal and vertical distributions of soluble reactive phosphate, total phosphorus, nitrate, ammonia and silicate. Their seasonal variations are presented and discussed.

Complete depletion of soluble reactive phosphate was observed in certain portions of the epilmnion during the month of July. The horizontal and vertical distributions of nitrate, silicate and soluble reactive phosphate generally reflected the temperature-biological structure of the lake rather than indicating input sources. The horizontal distribution of total phosphorus, however, did suggest possible inputs of phosphorus to the lake.

Factor analysis was applied to the nutrient data to obtain correlations with other physical and chemical parameters such as dissolved oxygen, alkalinity, turbidity and temperature.

141. Sibley, T. H. and K. M. Stewart. 1969. Some variation in the quality of water from the source and mouth of the Niagara River. Proceedings 12th Conference Great Lakes Research. pp. 774-785.

An investigation in 1967 and early 1968 compared similarities and differences in selected variables of water quality from the source and mouth of the Niagara River. The source of the River is the large volume discharge from Lake Erie and the mouth is the point at which this discharge empties into Lake Ontario. Industrial and municipal wastes and some runoff from agricultural areas are discharged into the river along portions of Western New York (USA) and Ontario (Canada).

Comparisons were made of temperature, dissolved oxygen, pH, hardness, alkalinity, calcium, magnesium, sodium, potassium, chlorides, total residue, fixed solids and conductivity. Chlorides and conductivity were continuously higher at the mouth. The mean values of all parameters, except total residue and fixed solids, were slightly higher at the mouth. Although the increases were relatively slight, the discharge from Lake Erie is so great that even slight changes in the water quality between the source and mouth represent impressive inputs into the river.

142. Skoch, Edwin J. 1970. Changes in the sediment chemistry of Lakes Erie and Ontario. In: R. A. Sweeney (Ed.). Proceedings of the Conference on Changes in the Chemistry of Lakes Erie and Ontario. Bull. Buffalo Society Natural Sciences. 25(2): 67-76.

Lakes Erie and Ontario are quite similar in their sediment characteristics. Differences in the chemical composition of the sediment are possible due to depth differences and material inflow. Despite the fact that the sediment plays an important role in the cycling of meterials in the lake system, very little data are available on this topic. No data were discovered which would show changes in sediment chemistry over the years. The data now available were randomly gathered and often not comparable in the differences in analytical procedures and the time and techniques of sampling.

Soyugenc, M. - See: L. R. Hedrick, No. 68.

Stewart, K. M. - See. T. H. Sibley, No. 141.

143. Storr, J. F. 1964. Limnology-Nine Mile Point, Lake Ontario. Niagara Mohawk Power Corporation, Syracuse, New York. In: Preliminary Summary Hazards Rept. U. S. AEC Docket No. 50-220 Appendix B, Vol. II. pp. B1-B82.

The author used the presence of a high chloride content found in the Oswego River water (at times over 300 ppm) above that found in the lake as an indicator in tracking the water movement past the Nine Mile Point plant site and beyond. Consequently, contour diagrams showing the chloride concentrations in Mexico Bay are included.

144. Sutherland, J. C., J. R. Kramer, Lee Nichols and T. D. Kurtz. 1966. Mineral-water equilibria, Great Lakes: silica and phosphorus. Great Lakes Research Division, Univ. Michigan. 15: 439-445.

Mineral-water equilibrium concepts are applied to November and January (1965-1966) Lake Ontario phosphorus and silica data. Soluble silica concentrations (0-1 ppm SiO_2) are very near equilibrium values predicted by gibbsite-kaolinite equilibrium. Phosphorus concentrations (9.6-28 ppb P) are slightly low with respect to hydroxyapatite equilibrium. A temperature fluctuation model predicts saturation with respect to hydroxyapatite with increasing temperature (summer) at approximately 20°C. Water extracted from 4 bottom sediment samples ranges from 11-25 ppm SiO_2 and represents water stable with respect to kaolinite, whereas phosphorus (approximately 90 ppb P) concentrations represent water exactly in equilibrium with respect to hydroxyapatite.

145. Sutherland, J. C. 1970. Silicate mineral stability and mineral equilibria in the Great Lakes. Environ. Science Technology. 4: 826-833.

Equilibrium concepts involving silicate minerals and water are applied to chemical data from the North Channel and Lakes Erie and Ontario and Huron for understanding of chemical self-regulation in the Great Lakes. Equilibria involving silicates and water are inferred from aqueous chemical data. Concentrations of dissolved silica attain minimum values of $10^{-4.8}$ mole/liter in surface waters of the remote lakes through dissolution of kaolinite,

$$\underset{\text{Kaolinite}}{Al_2Si_2O_5(OH)_4} + 5H_2O \text{ ----- } \underset{\text{Gibbsite}}{Al_2(OH)_6} + \underset{\text{Aq. silica}}{2H_4SiO_4}$$

In deeper waters, metastable equilibria, Ca montmorillonite gibbsite and muscovite gibbsite may impose upper limits upon concentrations of SiO_2(aq.). Silica concentrations in the enclosed waters of sediment from North Channel reach metastable equilibrium with amorphous silica at values of $SiO_2(aq.) = 10^{-2.8}$ mole/liter; values of less than 10^{-3} mole/liter are imposed in sediments from the other lakes through Ca montomorillonite ----- kaolinite. The major chemical character of the Great Lakes is inherited from the carbon-silicate mineralogy of bedrock, soil, and glacial drift in their drainage.

146. Sweeney, R. A. 1969. Effectiveness of a hopper dredge as an aerator and classifier of sediments. Research Report for the U. S. Army Corps of Engineers, Buffalo District. Great Lakes Lab, State Univ. College at Buffalo. 145 p.

In conjunction with a study of the effectiveness of hopper dredging, water and sediment samples of Rochester Harbor were taken before and after dredging.

Water samples were analyzed for pH, conductivity, BOD, dissolved oxygen, dissolved and suspended solids, dissolved, suspended and total phosphates, turbidity, nitrate, ammonia and organic and total nitrogen.

Sediment samples were analyzed for solids, oils, dissolved and total phosphates, ammonia, nitrate, organic and total nitrogen, COD, BOD and Cl demand.

147. Sweers, H. E. 1969a. Removal of contaminants from Lake Ontario by natural processes. Proceedings 12th Conference Great Lakes Research. pp. 734-741.

A model is developed to calculate the removal time of a conservative parameter from a lake, taking summer stratification into account. The basic assumptions of the model are compared with conditions actually occurring in Lake Ontario, and it is shown that stratification has little effect on the calculated removal time. The results are extrapolated to the behavior of non-conservative parameters. It is argued that a sharp reduction in the rate of input of nutrients could result in a marked decrease in algal growth within a year after such measures become effective.

148. Sweers, H. E. 1969b. Structure, dynamics and chemistry of Lake Ontario. Canadian Dept. Energy, Mines & Resources. Man. Rept. Series No. 10. 27 p.

Data obtained from a series of monitor cruises on Lake Ontario during the 1966 and 1967 field seasons are analyzed in detail. The horizontal and vertical distributions and seasonal variations of oxygen, specific conductance, pH, total alkalinity, hardness and chloride are studied in relation to the thermal structure and persistent local anomalies are pointed out.

149. Thomas, J. F. J. 1954. Industrial water resources of Canada water survey report No. 3 - Upper St. Lawrence River-Central Great Lakes drainage basin in Canada. Canada Dept. of Mines and Technical Surveys, Mines Branch Rept. No. 837. 212 p.

Tabulated data for the surface water of Lake Ontario at various cities located on the lake are presented on: dissolved O_2, CO_2, pH, color, turbidity, dissolved solids, specific conductance, Ca, Mg, Na, K, Fe, NO_2, hardness and temperature. Descriptive statements are included which give sample location and date.

150. Thomas, J. F. J. 1964. Surface water quality in major drainage basins and northern areas of Canada. Journal American Water Works Association. 56(9): 1173-1193.

This article summaries information on the chemical quality of major Canadian surface waters obtained by the mines branch since 1948.

Tabulated data is presented for the surface water of Lake Ontario and streams tributary to the lake on: Ca, Mg, Na, K, alkalinity, SO_4, Cl, conductance, silica, NO_3, pH, F, hardness, Fe and color.

Thomas, R. L. - See: D. S. Cronan, No. 46.

151. Thomas, R. L. 1969a. The qualitative distribution of feldspars in surficial bottom sediments from Lake Ontario. Proceedings 12th Conference Great Lakes Research. pp. 364-379.

A qualitative assessment of the feldspar distribution in Lake Ontario sediments has been made by the determination of the feldspar end members, K, Na and Ca, on sediment residues after fusion with potassium pyrosulphate. Both K adsorption and cation exchange of Na and Ca for K in standard feldspars was observed. Cation exchanged is shown to be minimal in samples and in standards with a full particle size range. K adsorption is high yet appears to be constant and not directly related to grain size. In the inshore zones a poor positive correlation of feldspar to quartz is believed to be the result of poor mixing in a traction load sediment. In the basin zones the relationship is of a higher order and reflects natural sorting by sedimentation from a suspended load.

The regional distribution of the feldspars shows an inshore to offshore decrease, initially of calcic feldspar than of sodic feldspar leading to a basin enrichment of the potash feldspars, microcline and orthoclase. The feldspars are probably derived predominantly by coast line erosion of glacial deposits surrounding Lake Ontario.

152. Thomas, R. L. 1969b. A note on the relationship of grain size, clay content, quartz and organic carbon in some Lake Erie and Lake Ontario sediments. Journal Sedimentary Petrology. 39: 803-809.

An examination of the geochemistry of fine-grained sediments in relation to size frequency distribution was carried out on sediment samples from Lakes Erie and Ontario. This study demonstrated a direct relationship between the 2 micron grain size and the theoretical clay content computed from the organic carbon, quartz and carbonate content. A sympathetic relationship was observed between clay content and organic carbon, and also between the median grain size and quartz content. The former relationship is believed to be the result of adsorption from solution and the latter is brought about by natural sedimentation from suspension.

153. Thomas, R. L., A. L. W. Kemp and C. F. M. Lewis. 1970. The distribution and characteristics of Lake Ontario surface sediments. Geological Society America, Annual Meetings, Milwaukee, Wisconsin. p. 703. (Abstract of unpublished paper presented at the annual meeting of the Geological Society of America, Milwaukee, Wisconsin, November 11-13, 1970).

A detailed reconnaissance sampling program of Lake Ontario surficial sediments was carried out in 1968. Sampling was carried out on an 8 km polyconic grid using a Shipek grab sampler. Sediment particle size, pH, Eh, organic carbon, carbonate carbon, quartz and mineral clay were measured in the top 3 cm at each station. Additional information was acquired by echosounding profiles of the lake. From the echograms sediment types could be characterized and their contacts well defined. Lake Ontario is partitioned by two north to south sills composed of glacial materials into three depositional basins which in turn are separated from the Kingston Basin to the northeast by an east to west trending bedrock sill. The nearshore zone of the lake is characterized by the occurrence of glacial materials. Glacial tills with surface lag gravels and sand outcrop around the periphery of the lake and were derived from the final ice retreat from the region. Offshore the tills are overlain by stiff, fine-grained laminated silty to sandy glaciolacustrine clays deposited in Lake Iroquois times and characterized by surficial lag sands. The glacio-lacustrine clays are succeeded offshore by the silty clays and clays of the depositional basins. The modern sediments of the lake pro-grade offshore into the deeper waters of each depositional basin. From inshore to offshore, a decreasing mean grain size is associated with decreasing quartz and increasing clay and organic carbon. The clay minerals are composed predominantly of illite with subsidiary kaolinite and chlorite. Carbonate carbon is related to the silt component of the sediment derived by weathering of the regional limestones.

154. Thomas, R. L. 1971. The distribution of mercury in the sediments of Lake Ontario. Unpublished paper presented at the 14th Conference on Great Lakes Research. April 19-21, 1971, Toronto, Canada.

During 1968, 262 sediment samples were taken on an 8 km grid sampling program of Lake Ontario. These have since been analysed for mercury and total major elements. The samples consisted of the topmost 3 cm of sediment and were freeze-dried immediately after recovery. Hg analyses were carried out by total combustion and atomic adsorption techniques.

The basic distribution of total mercury is related to the sediment distribution in the lake with increasing mercury concentrations in the offshore finer-grained sediments of the three depositional basins, the western or Niagara Basin, the central Mississauga Basin and the eastern Rochester Basin.

Thompson, R. E. - See: C. F. Schenk, No. 139.

155. Thon, J. 1969. Empirical relationship for total phosphorus system in the lower Great Lakes. Proceedings 12th Conference Great Lakes Research. pp. 786-688.

An empirical model describing the total phosphorus input and output relationship is based on current total phosphorus material balances for Lake Erie and Ontario.

Interrelated hydraulic, chemical and biological factors are incorporated within simplified basic assumptions. The model provides a rational basis for the forecasting of overall lake phosphorus levels and outputs in terms of mass, or concentration, under various total phosphorus input conditions.

156. Tiffany, M. A., J. W. Winchester and R. H. Loucks. 1969. Natural and pollution sources of iodine, bromine and chlorine in the Great Lakes. Journal Water Pollution Control Federation. 41: 1319-1329.

These preliminary survey data indicate that both Br and Cl are increasing in the Great Lakes by pollution as well as by natural sources. Iodine, however, does not appear to be a serious pollutant in the Great Lakes, except possibly in Lake Ontario. To a limited extent the data reported in this paper suggest that the relative Br/Cl pollution rate has increased in recent years and varies strongly with locality in the lower Great Lakes.

157. Toronto Department of Public Health. 1921. Report on the chemical, physical and bacteriological survey of Lake Ontario water. Toronto Dept. Public Health, Toronto. 15 p.

Tabulated data are presented for the surface water of Lake Ontario at Victoria Park and Mimico on: ammonia, Cl, temperature and coliform count (Canada Centre for Inland Waters).

158. Tressler, W. L. and T. S. Austin. 1940. A limnological study of some bays and lakes of the Lake Ontario watershed. In: A Biological Survey of the Lake Ontario Watershed. Bio. Survey (1939), (16), Suppl. 29th Annual Rept. NYS Conservation Dept. pp. 188-210.

During the summer of 1939 a number of bays and lakes of the Lake Ontario watershed were investigated to determine the amount and quality of microscopic life, the environmental conditions under which this life existed and the extent to which fish were utilizing this important food element in their diet. Vertical series at several depths were made in the water areas studied during the months of July and August. In the larger bays and river mouths, several additional stations were sampled at one meter depth in order to obtain a more complete picture of the area. Besides quantitative plankton studies, others were made on dissolved gases, pH, alkalinity, temperature, transparency and organic matter. Four bays of Lake Ontario (North and South ponds, Sodus and Irondequoit) were found to produce much more plankton than the lake itself. The organic matter was also considerably greater in the bays. Irondequoit Bay was the most productive of plankton, in spite of the fact that the region below 30 feet had anaerobic conditions and hydrogen sulphide. Glenwood and Carlton reservoirs were producing at the rate of about 108 lbs. per acre of organic matter during mid-summer; Redfield Flow was considerably below this figure in productivity. Of three ponds investigated (Coan, Mendon and Hindsburg Quarry) Hindsburg produced the largest amount of plankton. Organic matter was highest in Mendon Pond. Coan Pond showed many characteristics typical of a bog pond. The mouths of the Salmon, Oswego and Genesee rivers were samples and it was found that the Salmon was unpolluted and had a small amount of plankton, the Oswego was considerably polluted but the flow of water in the river was sufficient to offset most of the effects of waste materials, while the Genesee River mouth was heavily polluted and showed many unmistakable signs of pollution both in the chemical results and in the types of plankton organisms. Heat budgets for wind distributed heat, were calculated for four of the lakes and bays as follows: Redfield, about 7,200 gram calories; Carlton, 11,750; Glenwood, 8,550 and Irondequoit Bay 6,740 gram calories per unit area. Plankton was found to be scarce in the stomachs of a number of blunt-nosed minnows from Glenwood Reservoir; only 20% of the total catch examined contained plankton organisms, the remainder were filled with Red Medina sandstone. Plankton was also scarce in the stomachs of a number of common sunfish from Carlton Reservoir. The stomachs of perch and large-mouthed bass from Irondequoit Bay, contained a greater amount of plankton than the same species from Sodus Bay.

159. Tressler, W. L., T. S. Austin and E. Orban. 1953. Seasonal variations of some limnological factors in Irondequoit Bay, New York. American Midl. Naturalist. 49: 878-903.

A limnological investigation of Irondequoit Bay, a closed-in area of Lake Ontario at the eastern outskirts of the city of Rochester, New York, was made between August 15, 1939 and June 13, 1940. Series of samples at various depths were taken monthly to determine the seasonal variations in physical, chemical and biological factors. A summary of the findings is given below.

No oxygen was present during the summer in the deepest part of the lake (20 meters), below 10 meters depth. These conditions prevailed until the fall overturn in mid-November when oxygen was abundant at all depths. Oxygen was still absent at the bottom as late as mid-October.

Oxygen again became depleted during the winter (mid-March) in the bottom regions, a condition which shows extreme eutrophy. Oxygen was restored at the bottom during the spring overturn in April and May but by mid-June was again absent in the bottom water.

Free carbon dioxide was present in extremely high concentrations at stagnation periods in early fall and late winter.

Hydrogen ion concentration and alkalinity showed normal fluctuations for a highly eutrophic lake. Mean alkalinity was correlated with conductivity. Very marked increases toward the bottom in alkalinity were observed in August and March.

Mean organic phosphorus showed a definite correlation with mean organic matter.

Specific conductance was unusually high (600 units). Conductivity increased during the period from October to March, after which time it dropped off steadily.

360. Tucker, A. 1949. Pigment extraction as a method of quantitative analysis of phytoplankton. Trans. Amer. Microsc. Society. 68: 21-33.

The Harvey method as a means of estimating the abundance of phytoplankton in a single sample, is of little value because the standard error of estimate is too large to obtain a reliable result. However, because of its high correlation with actual count when many samples are considered, this method is of value as a means of estimating changes in total abundance of phytoplankton from lake to lake, from different stations or depths in the same lake, at one time, or during a period of time. From the statistical analysis, it can be seen that it has not been perfected sufficiently to be used other than as a general indicator. It does have the advantage of being a simple and rapid method in comparison with the tedious process of counting.

161. Upchurch, S. B. 1971. Chemical characteristics of the Great Lakes. Lakes and Embayment Subcommittee Working Papers - Great Lakes Basin Commission Comprehensive Framework Study. Ann Arbor, Michigan. 153 p.

This chapter develops a conceptual model for inorganic and organic chemical loads in the lakes, based on chemical weathering in the drainage basins, known chemical loads, and chemical equilibria. Temporal and spatial changes in water chemistry, regional distribution of chemical constituents and general sources of chemical loading are discussed. Sources and sinks for chemical constituents are related to buffering by both inorganic equilibria and organic assimilation. A chemical budget is presented to relate water chemistry in each lake to the entire Great Lakes system and to predict the consequences of discharging chemical effluents into the lakes.

162. U. S. Geological Survey. 1959. Quality of surface water of the United States, 1955. Water Supply Paper 1400. U. S. Geological Survey, Washington, D. C. 530 p.

Water quality data for water samples taken at the Genesee River at Rochester and the St. Lawrence at Alexandria Bay in 1955 are tabulated.

The samples were analyzed for silica, iron, calcium, magnesium, sodium, potassium, bicarbonate, sulphate, chlorine, florine, nitrate, oxygen demand and temperature.

163. U. S. Geological Survey. 1960a. Quality of surface water of the United States, 1956. Water Supply Paper 1450. U. S. Geological Survey, Washington, D. C. 603 p.

Water quality data for water samples taken at the Niagara River at Grand Island, New York, the Oswego River at Minetto, New York and the Black River at Watertown, New York in 1956 are tabulated.

The samples were analyzed for silica, iron, calcium, magnesium, sodium, potassium, bicarbonate, sulphate, chlorine, florine, nitrate, oxygen demand and temperature.

164. U. S. Geological Survey. 1960b. Quality of the surface waters of the United States, 1957. Water Supply Paper 1520. U. S. Geological Survey, Washington, D. C. pp. 627-629.

Tabulated data for the surface water of Lake Ontario for August 1957 are presented on: Ca, Mg, Na, K, SO_4, alkalinity, Cl, conductance, silica, pH, hardness, Fe, dissolved solids and color.

165. U. S. Geological Survey. 1964. Quality of surface waters of the United States, 1962. Parts 3 & 4. Ohio River Basin and St. Lawrence River Basin. Water Supply Paper 1942. U. S. Geological Survey, Washington, D. C. 322 p.

Tabulated data are presented for the surface waters of minor streams tributary to Lake Ontario.

The water is analyzed for silica, Ca, Mg, K, Na, HCO_3, SO_4, Cl, F, NO_3, dissolved solids, hardness, specific conductance, pH and color. The date of sampling is also given.

166. U. S. Geological Survey. 1965. Quality of surface water of the United States, 1959. Water Supply Paper 1642. U. S. Geological Survey, Washington, D. C. 303 p.

Water quality data for water samples taken at the Niagara River, Niagara Falls, New York, the Genesee River at Rochester, New York, the Black River at Watertown, New York and the St. Lawrence River at Alexandria Bay in 1959 are tabulated.

The samples were analyzed for silica, iron, calcium, magnesium, sodium, potassium, bicarbonate, sulphate, chlorine, florine, nitrate, oxygen demand and temperature.

167. U. S. Geological Survey. 1967. Water resources data for New York, 1965. Part 2. Water Quality Records. U. S. Geological Survey, Water Resources Division, Albany, New York. 112 p.

The basic records for the 1965 water year for quality of surface water, ground water and precipitation within the State of New York are given in this report.

Tabulated data are presented for the surface water of the Black River at Watertown, New York and other minor streams tributary to Lake Ontario.

The water is analyzed for silica, Fe, Mg, Ca, Mn, Na, K, HCO_3, SO_4, Cl, F, NO_3, dissolved solids, hardness, pH, specific conductance, color, turbidity and temperature. Descriptive statements are also included which give sample location and date of sampling.

168. U. S. Geological Survey. 1968a. Quality of surface waters of the United States, 1960. Parts 3 & 4. Ohio River Basin and St. Lawrence River Basin. Water Supply Paper 1742. U. S. Geological Survey, Washington, D. C. 309 p.

Tabulated data are presented for the surface water of the Black River at Carthage, Watertown and Glenfield, New York and other minor streams tributary to Lake Ontario.

The parameters measured include silica, Fe, Ca, Mg, Na, K, HCO_3, SO_4, Cl, F, NO_3, dissolved solids, specific conductance, pH and color. The date of sampling was also included.

169. U. S. Geological Survey. 1968b. Quality of surface water of the United States, 1961. Water Supply Paper 1882. U. S. Geological Survey, Washington, D. C. 312 p.

Water quality data for water samples taken at the Genesee River at Rochester, New York; Irondequoit Bay, New York and the Little Salmon River are tabulated.

The samples were analyzed for silica, iron, calcium, magnesium, sodium, potassium, bicarbonate, sulphate, chlorine, florine, nitrate, oxygen demand and temperature.

170. U. S. Geological Survey. 1968c. Water resources data for New York, 1966. Part 2. Water Quality Records. U. S. Geological Survey Water Resources Division, Albany, New York. 168 p.

The basic records for the 1966 water year for quality of surface water, ground water and precipitation within the State of New York are given in this report.

Tabulated data are presented for the surface water of the Black River at Watertown, New York, the Oswego River at Oswego, New York, the St. Lawrence River at Ogdensburg, New York and other minor streams tributary to Lake Ontario.

The water is analyzed for silica, Fe, Ca, Mg, Na, K, HCO_3, SO_4, Cl, F, NO_3, dissolved solids, hardness, specific conductance, pH, color and temperature. Descriptive statements are also included which give sample location and date of sampling.

171. U. S. Geological Survey. 1969a. Water load of uranium, radium and gross beta activity at selected gaging stations water year 1960-1961. Water Supple Paper 1535-O. U. S. Geological Survey, Washington, D.C. 31 p.

Water samples were collected from 36 rivers during low, medium and high flows. The drainage areas above the sampling sites represented about 55 percent of continental United States (including 86,000 sq. miles of Alaska) and 155,000 sq. miles of Canada. During the 1960-61 water year the total uranium-solute load ranged from about 100 pounds contributed by the Nezinscott River to 695,000 pounds contributed by the Mississippi River. The calculated total uranium-solute load of the rivers sampled was used to estimate that about 2 million pounds of uranium was carried from the continental United States to the oceans during the water year. The calculated radium-solute load for the sampling period ranged from about 2.5 x 10^{-5} pounds for the Nezinscott River to 25,000 x 10^{-5} pounds for the Mississippi River. The gross solute load of radium from the conterminous United States to the oceans for water year 1960-61 was estimated to be about 67,000 x 10^{-5} pounds.

172. U. S. Geological Survey. 1969b. Quality of the surface waters of the United States, 1964. Parts 3 & 4. Ohio River Basin and St. Lawrence River Basin. Water Supply Paper 1955. U. S. Geological Survey, Washington, D. C. 440 p.

Tabulated data are presented for the surface water of the Oswego River at Oswego, New York and other minor stream tributary to Lake Ontario. The parameters measured include silica, calcium, magnesium, potassium, sodium, bicarbonate, sulphate, chlorides, floride, nitrate, dissolved solids, hardness, specific conductance, pH, color and turbidity. The date of sampling is also given.

173. U. S. Geological Survey. 1969c. Water resources data for New York, 1967. Part 2. Water Quality Records. U. S. Geological Survey Water Resources Division, Albany, New York. 160 p.

The basic records for the 1967 water year for quality of surface water, ground water and precipitation within the State of New York are given in this report.

Tabulated data are presented for the surface water of the Black River at Watertown and Carthage, New York, the St. Lawrence River at Ogdensburg and other minor streams tributary to Lake Ontario.

The water is analyzed for silica, Ca, Mg, Na, K, HCO_3, SO_4, Cl, F, NO_3, dissolved solids, hardness, specific conductance, pH, color and temperature. Descriptive statements are also included which give sample location and date of sampling.

174. U. S. Geological Survey. 1970. Water resources data for New York, 1968. Part 2. Water Quality Records. U. S. Geological Survey Water Resources Division, Albany, New York. 137 p.

The basic records for the 1968 water year for quality of surface water, ground water and precipitation within the State of New York are given in this report.

Tabulated data are presentd for the surface water of the Black River in Watertown, New York, the St. Lawrence River at Ogdensburg, New York and other minor tributary streams to Lake Ontario.

The water is analyzed for silica, Ca, Mg, Na, K, NH_4, HCO_3, SO_4, Cl, F, NO_2, NO_3, organic N_2, total PO_4, dissolved solids, hardness, alkalinity, specific conductance, pH, color and temperature. Descriptive statements are also included which give sample location and data and time of sampling.

175. U. S. Geological Survey. 1971. Water resources data for New York, 1969. Part 2 Water Quality Records. U. S. Geological Survey Water Resources Division, Albany, New York. 119 p.

The basic records for the 1969 water year for quality of surface water, ground water and precipitation within the State of New York are given in this report.

Tabulated data are presented for the surface water of the Black River at Black River and Watertown, New York, the Eighteenmile Creek at Lockport, New York and other minor streams tributary to Lake Ontario.

The water is analyzed for alkalinity, dissolved solids, methylene blue active substances, COD, F, NO_2, NO_3, organic N_2, total PO_4, hardness, specific conductance, pH, color and temperature. Descriptive statements are also included which give sample location, date and period of records.

176. U. S. Public Health Service. 1963. National water quality network. Annual compilation of data, October 1, 1961-September 30, 1962. U. S. Public Health Service, Publication 663. 909 p.

Tabulated data for the surface water of the Niagara River at Buffalo, New York are presented on: Na, K, alkalinity, SO_4, Cl, conductance, pH, Mn, Cu, Pb, Zn, Cd, Cr, Co, F, radioactivity, hardness, turbidity, Ba, Fe, PO_4, NH_3-N_2, dissolved solids, BOD, color, COD, coliform count, Cl demand, ether solubles, B, Mo, ^{90}Sr, Se, Be, Sb, Ag, Sn, Bi and V.

177. Vallentyne, J. R., W. E. Johnson and A. J. Harris. 1970. A visual demonstration of the beneficial effects of sewage treatment for phosphate removal on particulate matter production in waters of Lake Erie and Lake Ontario. Journal Fish. Res. Board of Canada. 27: 1493-1496.

Filtered samples of raw sewage, biologically treated sewage, and sewage treated chemically for phosphate removal were added to unfiltered waters from lakes Erie and Ontario, and particulate residues (PR) on Millipore filters photographed after incubation in light for 10 and 30 days. PR levels in the sewage-enriched flasks were least in the case of sewage treated for removal of phosphates. Addition of phosphate to the phosphate-depleted effluent increased its PR generating ability to that of raw and biologically treated sewage. The removal of phosphates from sewage wastes thus appears to eliminate their fertilizing effect.

Vollenweider, R. A. - See: Y. K. Chau, et.al., No. 41.

178. Wagner, F. E. 1926. Chemical investigations of the Genesee River system with especial reference to pollution. In: A Biological Survey of the Genesee River System. Suppl. 16th Annual Report (1926), NYS Conservation Department, Albany, New York. 29-37 + Appendix.

Water quality data were obtained for water samples taken from various points along the Genesee River including the mouth.

The parameters measured included temperature, carbon dioxide, dissolved oxygen, alkalinity and pH.

179. Wagner, F. E. 1927. Chemical investigation of the Oswego Watershed. In: A Biological Survey of the Oswego River System. Suppl. 17th Annual Report (1927), NYS Dept. Conservation. pp. 108-132.

Water quality data were obtained for water samples taken from the Oswego River at various points including the mouth.

The parameters measured included temperature, dissolved oxygen, alkalinity, carbon dioxide and pH.

180. Wagner, F. E. 1929. Chemical investigation of the Erie-Niagara watershed. In: New York State Conservation Department "A Biological Survey of the Erie-Niagara System." Suppl. 18th Annual Report (1928), NYS Conservation Dept. pp. 107-133.

Chemical analysis data for water samples collected from the Niagara River in 1928 at various points are tabulated. Parameters include dissolved oxygen, alkalinity, carbon dioxide, pH, 10 day BOD and temperature.

181. Weaver, L. C. G. Gunnerson, A. W. Breidenbach and J. J. Lichtenberg. 1965. Chlorinated hydrocarbon pesticides in major U. S. River Basins. Public Health Service, U. S. Dept. Health, Education and Welfare, Public Health Repts. 80(6): 481-493.

Extensive surveillance for chlorinated hydrocarbons and other synthetic organic pollutants has been underway by the Public Health Service for several years. Recent development of analytical procedures capable of measuring pesticides in the parts-per-trillion range on grab samples made it desirable to conduct a special synoptic survey of pesticide pollution in the various U. S. River systems during September, 1964.

In order of frequency of occurrence, dieldrin, endrin, DDT and DDE were found in all major river basins. Heptachlor and aldrin were less abundant. DDD was detected at only one station; and no indication of heptachlor epoxide was seen at any station. These latter results may have been due to the lower sensitivity of the procedure for these three compounds. Generally, both the occurrences and concentrations found in grab samples from the synoptic survey were in accord with the results of previous analyses of samples obtained by the carbon adsorption method.

Weiler, R. R. - See: A. Lerman, No. 96.

182. Weiler, R. R. and V. K. Chawla. 1969. Dissolved mineral quality of Great Lakes waters. Proceedings 12th Conference Great Lakes Research. pp. 801-818.

In 1968 the Canada Centre for Inland Waters undertook a systematic monitoring of Lakes Ontario, Erie, Huron and Superior in a study of the major (Ca, Mg, Na, K, SO_4, Cl, HCO_3 and F) and trace (Zn, Cu, Pb, Fe, Ni, Cr, Mn and Sr) elements. The data gathered on major elements during the period July to November 1968 were examined and the results compared on a lake-wide basis with earlier compilations to appraise recent trends and comparisons of the trace element composition of the Great Lakes waters is discussed.

183. Weiler, R. R. and M. E. Fox. 1970. The composition of the interstitial waters in the sediments of Western Lake Ontario. Unpublished paper presented at the 13th Conference on Great Lakes Research, Buffalo, New York, April 1-3, 1970. pp. 208-209.

Between May and August, 1968, the sediments in Western Lake Ontario were sampled repeatedly by coring at four locations. The interstitial water in the top twelve inches was extracted, using a non-metallic pistonless squeezer activated with an inert gas. The interstitial in each of the six two inch sections, into which the core was divided, and the water immediately above the sediment was analyzed for the major cations and anions, as well as phosphate, nitrate, silica, iron and manganese.

In addition, the mineralogy of the sediments was determined by X-ray diffractometry and by the Department of National Health and Welfare. No sulphate was present in most water samples and only the major ions did not show a general decrease in the depth. Excepting sulphate, the concentration of all ions in the interstital water was greater than that in the water immediately above the cores.

184. Weiler, R. R. and R. Coker. 1971. Some chemical effects of the thermal bar in Lake Ontario. Abstract of paper presented at the 14th Conference on Great Lakes Research, Toronto, April 19-21, 1971. pp. 208-209.

During the period May 17 to 22, 1970, the effects of the thermal bar on the chemistry of the lake was studied along a line running roughly SE from Raby Head, east of Oshawa. The following parameters were measured hourly: temperature, pH, conductivity, dissolved oxygen, chlorophyll a, filtered reactive phosphate, filtered nitrate and filtered silica. Filtered and unfiltered samples were also collected every four hours for calcium and alkalinity; every six hours for total and inorganic carbon and total phosphorus; every twelve for trace metals.

185. Weist, W. G. and G. L. Giese. 1969. Water resources of the central New York region. U. S. Geological Survey: State of New York Conservation Dept. Water Resources Commission. Bulletin 64, Albany, New York. 58 p.

Water quality data for the surface water of the Oswego River are given. Parameters discussed include SO_4, total dissolved solids, hardness and Cl.

Two maps are presented showing areas in the Lake Ontario drainage basin containing more than 500 mg/l of total dissolved solids and more than 250 mg/l of SO_4.

Winchester, J. W. - See: M. A. Tiffany, et.al., No. 156.

186. Winchester, John W. 1970. Chemical equilibria of iodine in Great Lakes waters. Proceedings 13th Conference Great Lakes Research. pp. 137-140.

Iodine in Great Lakes waters, 1-3 ug/l, is uniformly distributed and near the content of natural rainfall without evidence of strong additional pollution sources.

These concentrations, 20-60 times lower than in sea water, may present an environmental stress to organisms where iodine is an essential element. In the sea, iodine is utilized mainly as iodine by vertebrates and by brown and red algae. Although thermodynamically iodate is the most stable form in aerated water, about half the total iodine is believed to exist as iodine, and a biochemical recycling of iodide in the marine biosphere is suggested. In fresh water, blue-green and green algae are not known to require iodine and may not therefore aid in keeping iodine in the reduced form. Therefore, iodide available to vertebrates in lake water, and especially to anadromous fish which have become adapted to live in lake water, may be in much shorter supply than suggested by the low concentration of total iodine alone.

Yalkovsky, R. - See: D. T. Meloon, No. 107.

Yalkovsky, R. - See: D. T. Meloon, et.al., No. 108.

187. Zweig, G., J. H. Nair and B. Compton. 1967. A study of fat and oil pollution of New York State waters. NYS Dept. Health, Albany, New York. Research Rept. No. 16. 90 p.

Fat-like material found occassionally on the beaches of Lake Ontario in the vicinity of Rochester, New York was investigated. The fat was characterized by gas chromatography. Method for fat removal from waste water were evaluated.

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